# CHEMICAL & METALLURGICAL ENGINEERING

McGraw-Hill Co. Inc.

25 cents per copy

April 28, 1924

McGraw-Hill Company, Inc.
James H. McGraw, *President*
E. J. Mehren, *Vice-President*

# CHEMICAL & METALLURGICAL ENGINEERING

H. C. Parmelee
*Editor*

Volume 30 New York, April 28, 1924 Number 17

## $25,000 Prize Withdrawn From American Chemical Society

AT THE Pittsburgh meeting of the American Chemical Society in September, 1922, the Allied Chemical & Dye Corporation announced the establishment of "an annual prize of $25,000 to reward the chemist, residing in the United States, who in the opinion of a properly constituted jury has contributed most to the benefit of science and of the world." The society was asked to set up the necessary machinery for the administration of the award. At the Washington meeting of the society last week a letter was read to the council from the corporation withdrawing its proposal to avail itself "of the American Chemical Society's good offices in connection with the administration of our proposed award for outstanding accomplishment in the field of chemistry." Thus in the short but painful period of 20 months was the glad acclaim and buoyant enthusiasm of Pittsburgh turned into the gloom and disappointment of Washington.

But if the announcement fell like a bombshell in the council, it was not unexpected by the committee of the society that has endeavored for more than a year to meet the wishes of the corporation in awarding the prize; for the committee recommended "that the American Chemical Society should pass a vote relinquishing the acceptance of the administration of this prize." Happily for the leadership of the society and the confidence of the council in its committee of eminent chemists appointed last September, a stormy scene was avoided and the committee's report adopted. A spirit of moderation prevailed and the council conducted itself with gentlemanly decorum in a difficult situation which, under less skillful direction, might easily have developed unhappy consequences.

One cannot read the letter of the Allied Chemical & Dye Corporation without observing the naïve manner in which the American Chemical Society is made to bear the burden of responsibility for the corporation's action in withdrawing its proposal. It is in marked contrast with the felicitous vein in which the offer was originally made and with the confidence then expressed. In 1922 the corporation said: "We have not gone into details, as we value greatly the opinions of those who would naturally be asked to serve on the committee, and do not desire to trammel them in their deliberations." In 1924: "We face the fact, however, that in the rather long course of our approaches toward such co-operation, your own [Dr. Edgar F. Smith's] splendidly earnest and understanding work as the society's representative has, unfortunately, not resulted as we had hoped in the society's formulation of a plan of administration which could appropriately be put into effect." Thus ended the labors of Edgar F. Smith, Charles F. Chandler, Ira Remsen, Theodore W. Richards and Francis P. Venable. They reported that "In consultation with the officials of the Allied Chemical & Dye Corporation we have found that this corporation no longer desires the co-operation of the American Chemical Society in the administration of the prize which they recently announced." The record may be variously construed, but members of the society who know most of the history of the negotiations relinquish the project "with great relief" and are "glad that it is all over."

## A Proper Perspective On the Nitrogen Situation

PART two of the Nitrogen Survey of the Bureau of Foreign and Domestic Commerce, just released, represents a high type of government report. Without attempting to exhaust the subject or speak with finality, it presents a satisfying volume of statistics that speak for themselves. It should have a healthy influence in a rather unhealthy muddle, because it gives the most dependable perspective of the whole nitrogen situation that has recently been available.

Due to the political as well as the economic aspects of the nitrogen problem, there has been a vast amount of misinformation on the subject, distorted by exaggeration and partisan enthusiasm. The Muscle Shoals controversy has made the whole matter in this country a political football, with inevitable propaganda, much of which has been intentionally misleading. Hence the satisfaction with which industry will receive the unbiased and authoritative information emanating from the Bureau of Foreign and Domestic Commerce.

In this issue *Chem. & Met.* presents appropriate parts of the report, indicating the magnitude of the fixed nitrogen problem as revealed by the data on consumption, distribution, exports and imports. In subsequent issues other sections of the report will be published, dealing successively with fixed nitrogen and the food supply, fixed nitrogen from coal and fixed nitrogen in animal waste and Chilean nitrate. The last-named commodity will be considered from the point of view of consumption only, as the first section of the report, abstracted in *Chem. & Met.* Jan. 7, 1924, dealt with Chilean nitrate supply. Additional sections are promised on nitrogen fixation in the United States by means of catalytic processes.

Measured by any standard, whether in its relation to industry, agriculture or military requirements, the subject of nitrogen is deserving of serious constructive thought. None of these three interests should dominate the industry at the expense of another, except possibly that of military requirements in time of war. On the contrary, the proper relationship of supply and demand for the several groups must not be neglected if we are to have an even and balanced development of this great key industry of the future. Dr. Harry A. Curtis, special investigator in charge of the survey, and his collaborators have completed a work that deserves congratulation, and we commend a careful study of the report to those who have either a casual or an intimate interest in the subject.

## A Measurement of Competitive Value

ONE of the most difficult problems confronting the engineer arises from the necessity of making a choice between the several types of equipment that may be available for accomplishing some process or operation. General facts will in most cases be obtainable which will limit the choice to a rather narrow field. But within this field both the utility and the cost will vary, and it is the engineer's task to decide which of the combinations of these two qualities to be had represents the optimum.

In discussing this problem as encountered in the sphere of power generation, Dr. C. E. Lucke, of Columbia University, recently laid down a method of procedure that will be helpful in many other lines of endeavor. It was his premise that to each means of power generation can be applied a measure of competitive value. This measure is made up of two factors: suitability and total cost. Suitability is obvious; but cost is not, and must be the subject of analysis. The total cost of any process is made up of three items: losses of energy or whatever in the process, investment in equipment, and operating disbursements. Obtain the true total cost of any equipment in this way and then it becomes easy to make a choice among those types of equipment which may have the other principal requirement of suitability.

Of course, one obstacle in the way of applying such a method to the choice of chemical plant will immediately come to mind. It will be said that, while the losses or inefficiency, the investment cost and the operating disbursements are easily obtainable for power plant apparatus, they are not all so for chemical engineering. This is undoubtedly true, but in some measure they are available today. Of course the investment cost is. And the two other factors can at least be closely approximated. And after a while, if the method is adopted, the engineer will build up a sufficient mass of facts to enable him to make an easy and correct judgment when any question of choice among types of equipment comes before him.

## Precautions in Handling Gas Anesthetics

WITH no small measure of satisfaction we learn that our recent editorial on "Chemistry for Physicians" has evoked some serious discussion in the medical profession. Our readers will recall that the editorial in question pointed to the unfortunate explosion of anesthetic gases in a Baltimore hospital as particularly convincing evidence of the need on the part of the physician for a practical knowledge of the fundamentals of chemistry. Since our original comment was published several important facts have come to our attention. It is reported that the patient had recovered from the ethylene administered and was put under again with nitrous oxide and oxygen. Five minutes later the explosion occurred. Without further data it is difficult to determine whether the blame rests with ethylene or nitrous oxide or possibly both, but the evidence is sufficient to emphasize most emphatically the necessity for unceasing vigilance in using these gases.

The use of ethylene is one of the most recent developments in the field of gas anesthetics. It is important to note that from the beginning both the investigators and the manufacturers have recognized that ethylene, like ether, is flammable and have done their utmost to call attention to the precautions that must be observed in its use.

Dr. Arno B. Luckhardt of the Presbyterian Hospital and the Hull Physiological Laboratory of the University of Chicago is co-author with J. B. Carter of a distinguished paper on the subject of "Ethylene as a Gas Anesthetic," which appeared in the May 19, 1923, issue of the *Journal of the American Medical Association*. The authors' first conclusion is this:

> We append a note of warning to those who contemplate using ethylene in the clinic. Ethylene gas is flammable. It forms, moreover, with air (or oxygen) an explosive mixture in a concentration of four volumes of ethylene with ninety-six volumes of air. Until further work, now in progress, has been performed on its explosive properties, we warn surgeons and anesthetists not to use the gas in the presence of an electric spark, the actual cautery or a free flame.

In a second paper with Dean Lewis of Chicago, published in the Dec. 1, 1923, issue of the same journal, Dr. Luckhardt summarizes the very satisfactory clinical results that have been obtained with ethylene-oxygen anesthesia in over 800 cases in the Presbyterian Hospital. But he again emphasizes his warning about the explosibility of the mixture. Although "it is not quite so explosive as ether vapor," the authors declare that they "write not to alarm but simply to caution those who might otherwise be careless of its use. Knowing that, like illuminating gas and ether vapor, it forms with air and oxygen highly explosive mixtures, it behooves all in the interest of all and everything to be extremely cautious in its administration."

In addition every cylinder of ethylene bears a conspicuous warning label, and instructions sent with each shipment are particularly emphatic in their specific warning against the dangers attending the use of the cautery in the presence of ethylene vapors.

Many physicians will be inclined to wonder at our mention of nitrous oxide as a possible factor in the explosion. This gas has been used for many years, the technique of its administration has been thoroughly developed and apparently most physicians feel that there is no explosion risk involved in its use. This false feeling of security results from the fallacy of contrasting the behavior of nitrous oxide-oxygen mixtures with that of ethylene-oxygen mixtures. As nitrous oxide is quite inert toward oxidizing agents, there is no reason to expect that its mixtures with oxygen should be flammable. On the other hand, nitrous oxide is a sufficiently powerful oxidizing agent to form explosive mixtures with oxidizable gases or vapors. A number of cases have been investigated and it has been shown that mixtures of nitrous oxide with hydrogen, hydrocarbons, carbon monoxide, ammonia, phosphine, hydrogen sulphide, cyanogen or sulphur vapor will explode in contact with a red-hot body or an electric spark. It is evident that ethylene-nitrous oxide and ether-nitrous oxide should be handled quite as cautiously as their respective mixtures with oxygen or air.

Furthermore, as pointed out in our first comment, nitrous oxide is a metastable compound; that is, under certain conditions it breaks up into nitrogen and oxygen with the liberation of a large amount of heat, 18,000 cal. per gram-molecule. While some of these conditions are known, there is still an element of uncertainty about

this decomposition. There is at least one case on record where a tank of liquid nitrous oxide exploded without apparent reason, and in recent investigations on the explosibility of ammonium nitrate prompted by the Oppau and Ammonite disasters attention is being directed to the possibility that nitrous oxide was a factor in the explosions.

This discussion leads to the obvious conclusion that physicians, when dealing with such materials, should spare no effort to become thoroughly familiar with all of the facts that the chemical profession is able to place at their disposal. The attitude of ignoring such opportunities for co-operation is unfortunately all too common among physicians. It is a sort of superficiality that puts more store by clinical experience than by research based on fundamental knowledge. It is a hampering handicap that must be lifted if the medical profession is to take advantage of the progress that is being made in the application of science in other fields of human endeavor.

## Technical Control In New Industries

VERY few industries can escape the sequel to faulty technical control, however vehement the assertion that the experienced and "practical" operator is the ultimate arbiter of efficient processing. In some industries in which chemical engineering has played a significant part in recent years there is little experience on which to base practice; and successful processing sometimes involves a study of factors that demand the attention and skill of expert technicians, biologists and chemists.

Olives were first brought from Spain, and the pickling of the fruit was one of the manifold domestic activities in the missions of early California. Only comparatively recently, however, was the ripe fruit recognized as a marketable and appetizing commodity of high food value, the birth of a new industry being due to the initiative and courage of Mrs. Freda Ehmann, who in 1897 organized operations on a commercial scale and thus blazed a trail that has since been followed by many others.

The ripe olive industry is now one of considerable proportions, far exceeding in importance the olive oil industry of California. The processing is simple: The fruit after grading is stored in salt water, then treated in a lye solution, washed and canned in brine. The open cans are steamed to eject air, then sealed. After this comes the most important phase of the process, the sterilization of the contents of the cans by heat. This would appear a simple operation, and so it is; but the need for accurate technical control has been brought home to the packers on more than one occasion when ptomaine poisoning has been traced to insufficient sterilization. Unfortunately, the careful and the scrupulous suffered with the ignorant and the careless; and in 1918 the ripe olive industry almost came to a standstill because of public nervousness caused by reports of poisoning, traced in every case to the output from factories in which adequate control had not been exercised in the sterilization of the cans of fruit. State intervention was found necessary, and a regulation was made that all canned olives must be subjected to a temperature of at least 240 deg. F. for 40 minutes. The recovery of the industry has since been slow but sure. The factories are now equipped for accurate mechanical control, such instruments as recording thermometers and time regulators being familiar sights in every plant. Further, although the recording instruments are checked occasionally against readings from standard thermometers and clocks, the familiar 24-hour charts of temperature and duration of the sterilization period constitute a report of operations that is examined periodically by the state food authorities.

In the preparation of foodstuffs it occasionally happens that faulty technical control is a preliminary to serious consequences that will turn commercial success into failure over night. The lesson must be learned, however, although the punishment is sometimes sharp. In other industries, not overshadowed by the possibility of collapse by reason of momentary carelessness, the need for accurate control is realized; but no danger exists and the provision of adequate automatic control apparatus is often deferred because its use is not enforced by law. Success, however, is the result of strict standardization, which is attainable only by the elimination, so far as is possible, of the personal element in the regulation of such factors as time and temperature.

## One Way to Meet A Buyers' Market

MUCH is printed and said about the fact that the manufacturer now faces a buyers' market, for the first time in many years. Outside of a few lines, such as dwelling houses, in which a shortage still exists, competition forces the recognition of this condition. It is necessary to exert real salesmanship to make a sale today, whereas for many years all that was necessary was to inform the buyer how much goods he could have.

This change in the market is well recognized, but the course of conduct to adopt in order that sales may be successful in spite of it is not so well known. This was brought vividly before us the other day when the opportunity came to listen to a conversation between the sales managers of two paint companies. The first to speak expressed deep dissatisfaction with the state of the market. The paint he sold was, he said, as good as ever and the price was right, but his business was so poor as to enable him to make almost instantaneous deliveries. "How is it," he asked the second sales manager, "that your plant, with a competing product, seems to find no difficulty at all in booking orders enough to absorb your full capacity?"

"Well," said the other, "it's this way. We saw that we'd have to face the hardest kind of a market when the late lamented boom ended. In casting about for some way to keep our business going we hit upon a plan that seems to have worked. Just as you do, we keep our price as low as that of any of our competitors. But we go further, and here's the point of the whole plan. We keep our quality just a bit better than anyone else does, so that our customer is assured of a better product for the standard price. How do we do it, you say? Well that is our secret. But I'll go just far enough to give you a hint. Four years ago we started an honest to goodness research department in charge of a thoroughly capable technical man. Through his efforts we make a better paint than ever before and we can still cut the price a few cents without running into the red. Think it over!"

# Washington Meeting of the American Chemical Society

## Editorial Staff Report

MANY superlatives suggest themselves to the reporter of the spring meeting of the American Chemical Society, held in Washington, April 21 to 24, 1924. The largest registration of any gathering in the history of the society. A most enthusiastic introduction to the great scientific workshops of the government departments. A brilliant program centering around such noblemen of science as Robert A. Millikan, this year's recipient of the Nobel prize in physics, and Gilbert N. Lewis, Willard Gibbs medalist for 1924. A memorable business session and a notable improvement in divisional and sectional papers—these are some of the impressions carried away from the activities of a busy week. The scientific as well as popular sightseeing, the trip to historic Mount Vernon and the interesting and instructive visit to Chemical Warfare Service headquarters at Edgewood Arsenal are other features of the convention not soon to be forgotten.

### Council Deliberates

Very much to the credit of the society and its governing body was the 4-hour business meeting of the council, held last Monday afternoon at the Willard. Important general problems such as classified membership and intersectional meetings were threshed out with a minimum of wasteful argument, and a number of other society matters came up for decision and debate.

Dr. Martin H. Ittner, chief chemist of Colgate & Co. and chairman of the society's committee on industrial alcohol, reported on the committee's recent activities, particularly in protest against certain objectionable features of the so-called Crampton bill (H.R. 6645). In urging that there should be established a Commissioner of Industrial Alcohol whose duties should be the enforcement of those portions of the law that pertain to the use of alcohol and alcoholic liquors for non-beverage purposes, the society's representatives made this significant statement to the House Judiciary Committee:

> We call attention to the necessity for the encouragement of lawful industries dependent upon the use of alcohol and we call attention to the fact that these industries should be permitted to manufacture, sell, buy or use alcohol, as the case may be, as a right existing under the Constitution of the United States and under statutes, subject to reasonable regulations, and not because of any privilege which may be within the province of a Prohibition Commissioner to grant or withhold in accordance with his individual ideas.

Because of the constant necessity for meeting just such problems as that arising with this proposed legislation and also because of the advisability of working closely with those who administer the existing law, the committee on industrial alcohol asked to be continued.

The committee on intersectional meetings, of which Prof. C. E. Coates was chairman, reported favorably on the idea underlying these gatherings. The suggestion that intersectional meetings might eventually do away with the need for the spring meetings of the national society was, however, not approved by the committee, which

argued that there were certain sections of the country in which regional meetings were practically impossible. The society can best encourage intersectional meetings, it was held, by letting them work out their own salvation. They should be formally recognized by the national officers, but their organization should remain purely autonomous.

The problem of classified membership was not so easily disposed of by the council. William Hoskins of Chicago reported that his committee had found no serious demand for radical changes in the constitution, but there was a general feeling that something should be done to add significance to membership in the American Chemical Society. No scheme of classification of members was recommended, but in its stead the committee suggested some slightly restrictive changes in requirements for membership. Of the latter proposals most discussion was aroused by the suggestion that a baccalaureate training or its equivalent be set as the requisite. Arguing in favor of even more drastic restrictions, some of the councilors would have made membership so highly prized that non-member chemists would be looked upon with the suspicion of being unable to meet the society's requirements. Others made an equally strong plea for continuance of the present system, under which the organization had made its greatest progress. As it was evident that the matter could not be settled at the meeting, the committee's recommendations were referred back to the local sections for decision and later report.

### Chemical Prize Withdrawn

But by far the greatest stir was caused by the reading of a short letter addressed to Edgar Fahs Smith by William H. Nichols, chairman of the board of the Allied Chemical & Dye Corporation. Dr. Nichols stated briefly that because in the corporation's estimation the American Chemical Society had not co-operated fully in the plans for administering the proposed annual prize of $25,000, to be awarded to the one who during the year had contributed the greatest advance to chemistry, the corporation had decided to withdraw its offer. No further explanation of the incident was forthcoming from the committee, which had included in its membership some of the most distinguished and respected members of the society. It merely filed a brief report that consultation with the officials of the Allied Chemical & Dye Corporation had revealed the fact that it no longer wished the co-operation of the American Chemical Society and this being the case it suggested "that the society should pass a vote relinquishing the acceptance of the administration of this prize." At the same time the committee expressed the hope "that the society will express deep appreciation of the purpose of the corporation in establishing a prize intended to redound to the good of chemistry in America and the welfare of American chemists." The committee's report was graciously accepted by the council and it was discharged with a statement of the society's gratitude for its services.

### California in 1925

A number of other matters of society business occupied the attention of the council. An informal expression of opinion indicated by an overwhelming vote the society's desire to accept the invitation of the various Pacific Coast sections to hold the summer meeting of 1925 in Los Angeles. Honorary membership in the society, proposed by forty-seven members and approved by a majority of the council, was awarded to Dr. S. P. L. Sorenson of Copenhagen, Denmark, after final approval by popular vote at the general meeting. Secretary Parsons reported that the society had shown a gain in membership, the total at the end of the year reaching 14,346, of which 1,028 were dropped on Jan. 1, 1924, on account of non-payment of dues. The secretary estimated that there are in the neighborhood of 10,000 non-member chemists in the United States at the present time.

## The General Session

It was appropriate that the general session should have been the largest and in many ways the most interesting general session ever held by the society. R. S. McBride, chairman of the Washington Section, welcomed the visitors and introduced Dr. Leo H. Baekeland, president of the society. In a felicitous introduction, Dr. Baekeland recalled the fact that 8 years ago in New York City Dr. R. A. Millikan and Dr. G. N. Lewis discussed the nature of the atom.

### The Atom of the Physicist

Prof. Millikan presented the physicist's conception, while Dr. Lewis pointed out the necessity of certain reservations to this brilliant conception, because of certain chemical evidence. It was, therefore, signally fortunate, continued Dr. Baekeland, to be able to listen to these two distinguished scientists in their presentation of the recent advances in our knowledge of subatomic phenomena. Prof. Millikan, the Nobel laureate in physics for 1924, began his discussion of atomic structure by stating those facts which are no longer considered controversial but are accepted not only by the physicists but by the chemists as well. This he did to emphasize the fact that there was no fundamental difference in thinking, but perhaps a difference in heritage—the physicist clinging more tenaciously to conventional mechanics in evolving his view of atomic structure. There is no doubt that there exists in the atom two different entities called positive and negative electrons and that, so far as we now know, there is nothing smaller than these units. Positive electrons are concentrated in a tiny space at the center of the atom. So small is this space that if we were to multiply the size of the atom by ten billion so that it would measure approximately a yard in diameter, the nucleus, positively charged, would be as big as the point of a pin. We know how many positive electrons there are in a nucleus and we know that the negative electrons are divided, some being in the nucleus and the rest being in outer regions, and finally we know how many negative electrons there are in the nucleus and the outer shells. Certain other things we know with regard to the energy and the frequency of atomic radiation, the kinetic energy of the radiation being a simple mathematical function of that radiation frequency.

Back in 1916 Lewis advanced a theory of atomic structure that postulated static electrons and it was dubbed the "loafer" electron theory, in contradistinction to the physicist's atom that postulated dynamic electrons whirling in orbits or, as Professor Millikan graphically put it, playing "ring-around-the-rosy." Lewis had advanced two objections to the physicist's theory, the first being that the dynamic electrons should

**General Meeting, A.C.S., Hotel Willard, April 22, 1924**
Some of the 1,500 "atom enthusiasts" assembled to hear the inspiring addresses of Prof. R. A. Millikan and Prof. G. N. Lewis.

ultimately dissipate their energy, and the second that an orbital theory failed to explain fixed valences in atoms (though this latter objection can be explained on an orbital theory so long as the orbits are not in the same plane).

In 1916 there was a mass of evidence that made the physicist loath to give up the dynamic theory. There was first of all the qualitative belief that conventional mechanics should not be thrown overboard without good reason. Again Summerfeld pointed out that some of the electrons have an elliptical orbit as others have a circular orbit and that the difference between the energy of these orbits is due to the fact that the elliptical electron is accelerated at perihelion. Calculating the dispersion of the lines of a spectrum doublet calculated from the energy necessary checks the experimental dispersion. Finally, in 1916 it was known that by applying astronomical laws to the perturbation in the electron orbit it was possible to predict all the lines of the Starck effect.

Recently Millikan has been working along the lines of stripping the valence electrons from the atoms of lithium, boron, carbon, nitrogen, etc. These have a series of spectra in which variations are due only to variations in atomic number exactly analogous to the changes that we now can measure in X-ray spectra of the elements. We have in fact a simple nucleus-one electron system and the same law should apply that holds for hydrogen—namely, the relatively doublet law—and it does. In other words, it is possible to calculate the electrons in the *K* and *L* shells by another approach and gives an additional confidence in the Einstein formula.

### The Chemist's Atom

Dr. Gilbert N. Lewis, of the University of California and Willard Gibbs medalist for 1924, pointed out that in 1916 there was a distinct misunderstanding on the part of the physicists and the chemists. They talked about electrons and they meant different things. The chemist referred actually to the electron and its orbit, and such a conception made both the static and the dynamic conceptions of the atom possible. He continued by pointing out the great difference between the physicist and the chemist in his approach to the problem of atomic structure. The physicist has a few laws based on marvelous experimental ingenuity and proves with quantitative exactness, whereas the chemist, a scientific roughneck so to speak, grapples with a vast volume of facts that cannot hope to be quantitative, neat and clean-cut. To use another of Dr. Lewis' happy analogies, after contact with an infinite variety of fact the chemist must play hunches. As an example of this sort of hunch, the chemist, from a mass of evidence, believes in pairs of electrons and points out the peculiar action of molecules that are known to have an uneven number of electrons. When two uneven molecules are brought into contact, they always clamp together. Numerous bits of confirmatory evidence of the pair conception are advanced by physicists in remarkable experimental work. Summerfeld has shown that atoms may be classed as magnetic or non-magnetic and that most of the atoms have either zero or one unit of magnetism. A few have two or more. But if we assume pairs of electrons, it is difficult for the chemist to design an atom that would be in any way satisfactory to the physicist, but as a kind of qualitative working basis, the following relationship might be suggested: An electron in its orbit produces a magnetic field and should exhibit then the properties of a magnet. If then two electrons are rotating in orbits toward each other and, therefore, in opposite directions, we have a situation similar to a pair of bar magnets with the north and south poles neutralizing each other. If, on the other hand, two electrons exist rotating side by side in the same direction, the effect should be the same as if the north pole of one magnet was touching the south pole of the other magnet; then the south and north poles respectively of these magnets would be intensified in their magnetic force. The parallelism between magnetism and chemical phenomena is the significant point deserving of emphasis. Especially significant is the recent work of Pascal, who has pointed out that a certain value of dia-magnetism may

be assigned to atoms and in the case of hydrocarbons this dia-magnetism is additive. However, with double bonds it is not additive, and the explanation of this may possibly be in picturing the magnetic planes as bending out of alignment, even to the point where a breaking is actually possible. Chemical evidence seems to indicate that chemical saturation is equivalent to magnetic saturation and that chemical action parallels magnetic action.

### Chemistry Expands

A particularly bright spot in the week's program was the address "The Expansion of Chemistry," by Dr. Edwin E. Slosson. To report it in its original brilliance is impossible, for the speaker's inimitable manner, his deft and skillful presentation were indeed the settings for his gems of cheerful, clever philosophy. Here can be reflected only a few sparkling excerpts from the interesting address:

"The reason why the chemist's influence over the world is not properly appreciated is because he works so silently, so unobtrusively. Sometimes, indeed, he sets off an explosion that is heard around the world. That makes people aware of his power, but does not add to his popularity."

"We will not properly understand the world's great literature until the teaching of English is transferred to the department of chemistry, or at least until the professors of English study chemistry."

"What was it that drew Columbus across the Atlantic? What was it that enticed Vasco da Gama to India around the Cape of Good Hope? What was it that sent Magellan around the world? It was 'the spicy breezes that blow soft o'er Ceylon's Isle.' The great explorers followed that spoor as the bee scents out the flower or the vulture his game. Some time I am going to write a book on 'The Influence of the Pepper Power Upon History,' in three large volumes."

"Diabetic patients taking insulin tell me the first effect of an overdose is a feeling of formless fear, a vague apprehension, a sense of futility and failure, a shiver of anxiety. Their courage can be at once restored by sucking a lollipop. A variation of a few hundredths of 1 per cent in the glucose of the blood may make the difference between cowardice and courage, may determine whether a man shall be shot as a slacker or medaled as a hero. Courage is not a matter of 'sand,' but of sugar."

"But chemists are, as I say, too modest and conservative, and keep their imaginations tethered closely to their test tubes. They even feel offended if one suggests to them that they should raise their eyes occasionally from their work and take a long look out of the window into the future."

# Heat Transfer Symposium

## The Outstanding Feature of the A.C.S. Meeting

**A Review of a Series of Practical Technical Papers That Serves to Summarize Present Knowledge of This Important Unit Process of Chemical Engineering**

*Since the idea of organizing the study of chemical engineering into a series of unit or basic processes common to many industrial operations first became current, it has spread rapidly and found general acceptance. Last year saw the publication of a notable text "Principles of Chemical Engineering," by Walker, Lewis and McAdams, in which this idea was presented in an epoch-making way. W. H. McAdams, one of the authors of that volume, acted as chairman of the session on heat transfer, one of these unit processes, which was held at the recent Washington meeting of the A.C.S. "Chem. & Met." presents herewith an abstract of the papers read at that session, made for us by Mr. McAdams.*

While heat transfer between oils and solids is treated directly in only one of the articles of this symposium, there are four others of peculiar importance to the oil industry. Twenty years ago the methods of this industry were of such a character that the recovery of waste heat was difficult or impossible, and fuel costs were so low that there was no incentive thereto. In recent years rising fuel costs and the greater heat consumption of modern processes have made heat economy essential, and fortunately modifications in operating methods have made it practicable. The industry is therefore vitally interested in the design of heat exchange equipment. While in such design the factors of low installation and maintenance, ease of cleaning, resistivity to corrosion, simplicity of operation and the like are of great importance, it is clear that these problems cannot be solved properly without an exact knowledge of the basic phenomena of heat transfer itself. Because of the wide dissimilarity of the products handled, especially as regards viscosity and volatility, the industry needs general formulas applicable in all cases of practice. Although a thoroughly general formula is not yet available, the articles referred to are of peculiar value to this industry because of the light they throw on this particular problem.

While the value of these generalizations in other fields is obvious, there is probably no single industry in which their importance is so great as in petroleum work.

Unless otherwise stated, the discussion in this part of the symposium refers to turbulent motion. The first

Presented before the Division of Industrial and Engineering Chemistry, American Chemical Society, Washington, D. C., April 22, 1924. To be printed in full in *Industrial & Engineering Chemistry*, May, 1924.

four of the papers following deal with the quantitative effect, upon the resistance to heat flow from the main body of the fluid to the inner wall of the pipe, or vice versa, of the various factors assumed to affect this resistance.

*1. Oils Flowing Inside Pipes, or in Annular Spaces; Mr. Garcia*—Heat transfer tests were made on commercial apparatus, such as exchangers and coolers, when handling petroleum hydrocarbons. The results* were compared to the equation for liquids offered in 1922 by McAdams and Frost (see *J. Ind. Eng. Chem.*, vol. 14, p. 1101, December, 1922), which was equivalent to the following:

*For Circular Pipes*

$$\text{(1)} \qquad \frac{l}{r} = h = 15.5\frac{k}{D}\left(\frac{Dus}{\mu}\right)^{0.796} = \frac{kR^{0.796}}{0.0645D}$$

wherein

- $h$ = coefficient of heat transfer between main body of liquid and the inner wall of the pipe = B.t.u. per hr. per sq,ft. of inner wall per deg. F.
- $r = l/h$ = "resistance."
- $D$ = actual inside diameter of the pipe, in inches.
- $u$ = average velocity of flow, as linear ft. per sec. = cu.ft. per sec. per sq.ft. of clear cross-sectional area.
- $s$ = specific gravity of the liquid.
- $\mu$ = absolute viscosity of the liquid at the average temperature of the film, in Poises.
- $k$ = absolute thermal conductivity of the stagnant liquid, as (B.t.u.) (ft.)/(sq.ft.) (deg. F.) (hr.).
- $R$ = "turbulence factor" = $Dus/\mu$.

For values of $R$ of below 12, the flow is viscous; above values of 40, the flow is turbulent; and between 12 and 40, the flow is unsteady, and either type of motion may prevail. Hence equation 1 should be used only above values of $R = 40$.

Mr. Garcia feels that "this equation agrees very closely with actual tests of exchangers and heaters used in industrial plants, and may be safely used for purposes of design."

For annular spaces, where no such specific data are available, $D$ is taken as equal to four times the hydraulic radius in inches.

For viscous flow, data are scarce. From a plot of the results of a number of his tests on oils, Mr. Garcia derives the following relation:

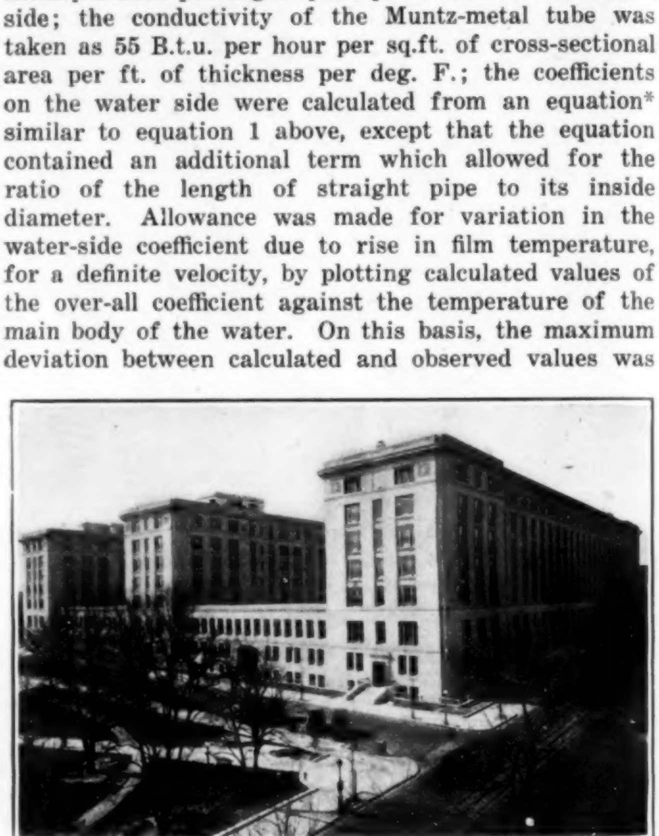
*For Viscous Flow of Liquids*

$$\text{(2)} \qquad \frac{l}{r} = h = \frac{24.1k}{D^{0.88}}\left(\frac{Dus}{\mu}\right)^{0.35}$$

wherein the meaning of all symbols is the same as in equation 1, except that the viscosity is taken at the average temperature of the main body of the liquid. The tests covered the following range: $D$ from 1 to 4 in., and $R$ from 0.4 to 16. While it is felt that more data are desirable, equation 2 is compatible with results of tests on 8-in. pipes recently published by R. S. Danforth. ("Oil Flow, Viscosity, and Heat Transfer," San Francisco, 1923.)

Test data and calculations are included for two pieces of commercial apparatus. In both cases the observed over-all coefficient of heat transfer closely checks the values predicted from the individual resistances calculated by equations 1 and 2. In the oil to oil exchanger, the flow of both residuum and crude was turbulent, while the oil flow in the cooler was viscous. To facilitate calculations, various alignment charts are given.

*2. Water Flowing Inside Pipes; D. K. Dean*—The object of this paper was to compare the observed over-all coefficients of heat transfer in a water-heater with those calculated from the available information on the individual resistances. The coefficient on the steam side for the test conditions was assumed constant at 2,175 B.t.u. per hour per deg. F. per sq.ft. of area on the steam side; the conductivity of the Muntz-metal tube was taken as 55 B.t.u. per hour per sq.ft. of cross-sectional area per ft. of thickness per deg. F.; the coefficients on the water side were calculated from an equation* similar to equation 1 above, except that the equation contained an additional term which allowed for the ratio of the length of straight pipe to its inside diameter. Allowance was made for variation in the water-side coefficient due to rise in film temperature, for a definite velocity, by plotting calculated values of the over-all coefficient against the temperature of the main body of the water. On this basis, the maximum deviation between calculated and observed values was



©Harris & Ewing.

**Department of the Interior Building**

only 4 per cent. A complete sample calculation was included, and a formula given by which may be calculated the square feet of surface required to produce a given rise in temperature of the water, for any steam temperature and water velocity.

*3. Water Flowing Inside Very Small Pipes; F. C. Blake and W. A. Peters, Jr.*—Heat transfer data were collected for the flow of water through a copper pipe having an inside diameter of $\frac{3}{16}$ in., heated by a low-voltage transformer, using the wall of the pipe as a resistor. The wall temperature at two points 5 in. apart was measured by copper-constantan thermocouples, soldered to the outer wall of the pipe. To measure the temperature of the water, a small hole was drilled opposite each of the two thermocouples, and a small thermocouple was inserted in a glass tube fastened directly opposite each hole. To obtain the flow of water through the section being tested, measurements were made of the water bled from the hole near the exit end, and the main portion of the water discharged from the copper pipe.

Six runs were made, each at constant water velocity, covering a range of 5 to 26 linear ft. per second. The results, corrected for the small percentage temperature drop through the wall of the copper pipe, were compared graphically with equation 1, which runs about 20 per cent higher than these experimental points. At the highest velocity, the coefficient from wall to water was 6,190 B.t.u. per hour per deg. F. per sq.ft.

*Paper by McAdams and Frost presented before joint meeting of A.S.R.E. and A.S.M.E. in New York, in December, 1923. For abstract, see *Chem. & Met.*, vol. 30, p. 234, Feb. 11, 1924.

Similar experiments were made using a steel tube of the same inside diameter, with the thermocouples 10 in. apart. The points in this case fall on a much higher curve, but the authors feel that the points obtained with the steel pipes are less accurate than those for the copper pipe, due to uncertainty in the thermal conductivity of steel.

The authors discuss their test procedure, and suggest attaching additional thermocouples to the pipe. They also point out that their method of obtaining water temperatures is different from the usual method by which the temperature at the center line of the stream is measured, and discuss the bearing of this factor on the results obtained.

4. *Heat Transfer Between Fluids and Solids, and Relation to Friction Drop; C. W. Rice*—The author of this paper is interested in developing a general formula that will apply to either a liquid or a gas when flowing past a solid surface. Most of the paper deals with turbulent flow of a fluid inside pipes. While fairly satisfactory heat transfer equations were available for either a liquid or a gas, the same constants did not apply to both cases. As a result of a study of the data of various investigators, some working on gases, and others on water, Mr. Rice evaluates the three constants in the original Nusselt equation and obtains the equivalent of the following:

*For turbulent motion of fluids flowing in smooth pipes*

$$h = \frac{l}{r} = \frac{ak}{D}\left(\frac{Dus}{\mu}\right)^{\frac{4}{5}}\left(\frac{\mu c}{k}\right)^{\frac{1}{2}} \qquad (3)$$

wherein the meaning of symbols is the same as in the two papers previously discussed, $c$ is the specific heat of the fluid at constant pressure, and $a$ is a constant dependent on the units used. In the original article, the numerical value of the constant $a$ is given for use when c.g.s. units are employed, and the heat current is expressed in watts. This equation is compared with equation 1, which omits the term $\sqrt{c\mu/k}$. For liquids, equation 1 gives a somewhat lower coefficient than does equation 3.

The analogy between friction drop and heat transfer is discussed in detail, and formulas are derived from which one may estimate the heat transfer from data concerning the friction drop. At the close of the paper, heat transfer formulas are tabulated for cylinders in ideal gases, fluids in pipes, large plane surfaces, mixtures of gases, etc.

5. *Optimum Operating Conditions for Pipe Heating and Cooling Equipment; W. K. Lewis, J. T. Ward and E. Voss*—It has long been known that when fluids are flowing in turbulent motion, an unduly high velocity gives rapid heat transfer rates and therefore reduces the expense of the heat transfer apparatus, but causes excessive friction and hence undue power consumption. Too low velocity reverses these conditions. Hitherto, the optimum economic velocity of flow has been determined by laborious graphical methods.

The authors of this article derive a simple direct formula for the determination of this optimum velocity for certain special cases, and indicate the procedure for other conditions. Where oil is being preheated while flowing through a steam-jacketed pipe, the formula indicates that the optimum velocity of the oil depends mainly on certain cost data, the density of the oil, and the inside diameter of the pipe, and only slightly on the viscosity of the oil. The most striking point is that this velocity is independent of the temperature of the condensing vapor, the temperature to which the oil is heated, and the numerical value of the coefficient of heat transfer.

Furthermore, it is well recognized that in the recovery of waste heat there is a percentage recovery beyond which the recovered energy costs more than it is worth. Formulas are developed for the determination of the economic allowable temperature to which one should heat or cool the fluid. While the formulas involve the numerical value of the over-all coefficient of heat transfer, as well as certain cost data, the former may readily be determined, now that the proper velocity is known, by referring to data of the type given in the four articles just discussed.

Attention should be called to the fact, insufficiently explained in the article itself, that the formulas presented apply only to special cases. However, the methods developed are general in scope. The equations for optimum velocity should not be employed unless the calculated velocity corresponds to turbulent motion. In other words, they should in no case be used if $R$ is less than 12, and preferably only when $R$ exceeds 40. For definition of $R$, the reader is referred to the discussion of Mr. Garcia's paper, given above.

6. *Characteristics of Air Blast Heaters; F. R. Ellis and J. D. White*—Descriptions are given of various types of heaters in which air is preheated by being blown at right angles to the outside of staggered pipes inside which steam is condensing. Based on numerous tests of certain types of heaters, curves are submitted to show the effect on the heat transfer, of steam pressure, mass velocity of air, and the initial and final temperatures of the air. To eliminate tedious calculation, a chart is submitted from which one can immediately determine the number of rows of pipe that must be employed at a given steam pressure and air velocity to warm the air from any chosen initial temperature to any final air temperature.

7. *Condensation of Water From Engine Exhaust Gas; R. F. Kohr and L. Butler*—The work on which this paper is based was occasioned largely by the proposed use of helium as a lifting gas in lighter-than-air craft. It is of course necessary to maintain static equilibrium during the flight of airships. Hitherto, where hydrogen gas has been used as the lifting gas, equilibrium has been maintained by valving the lifting gas to compensate for the loss in load due to the consumption of fuel. Obviously such waste is undesirable when using a lifting gas so rare and expensive as helium.

As a result of a survey of the possible means of maintaining equilibrium, it was decided to arrange to hold the load constant by condensing a weight of water equal to the weight of fuel consumed. Since the exhaust gases from a gasoline engine contain approximately 1.4 lb. of water vapor per pound of fuel burned, it is unnecessary to condense all of the water vapor. The cooling system finally adopted consists in long thin-walled aluminum tubes, the outer surfaces of which are cooled by the air flowing past the ship.

### Heat Transfer in Evaporators

1. *Heat Transmission in an Inclined Rapid-Circulation Type Evaporator; D. J. VanMarle*—Water was distilled under vacuum in an experimental evaporator with low-pressure steam condensing outside 3-in. tubes inclined at an angle of 45 deg. At a boiling temperature of approximately 142 deg. the over-all coefficient of heat transfer increased from 465 to 1,140 B.t.u. per

hour per sq.ft. per deg. F. as the over-all temperature difference increased from 42 to 81 deg. In another series, the over-all coefficient increased as both temperature difference and boiling temperature increased.

*2. Scale Formation in Evaporators; W. L. McCabe and C. S. Robinson*—As has long been known, due to the formation of scale on the heating surface, the over-all coefficient decreases. By assuming that under constant terminal conditions the thickness of scale deposited is directly proportional to the water previously evaporated, it is shown that the inverse square of the over-all coefficient should be a linear function of the total time. Data of three independent investigators are plotted in this way, and straight lines well represent the experimental points. The following data illustrate the magnitude of the effect of the scale in the three cases treated: for sodium sulphate solutions, after 6 hours the coefficient had dropped to 30 per cent of its initial value: for brine, after 10 hours, to 40 per cent; for cane juice, after 72 hours, to 79 per cent.

In conclusion, the authors state that this method of plotting may be used to predict the change in the over-all coefficient with respect to time, provided that two points on the curve are known and terminal conditions remain constant. Extrapolation within reasonable limits should be reasonably safe, provided no scale cracks off the heating surface.

*3. Effect of Surface Conditions on Heat Transfer in Evaporators; L. A. Pridgeon and W. L. Badger*—In studying over-all coefficients in evaporators, previous investigators have recognized the fact that the formation of scale on the liquor side of the heating surface had considerable influence on the results, and hence attempted to use clean tubes when studying the effect of other factors.

This paper reports results of tests on an experimental evaporator of the horizontal submerged-tube type, used for the distillation of water. Comparative runs were made with a certain arrangement of tubes, using first, rusty steel tubes, and second, new steel tubes. A plot of the results shows that the over-all coefficient increased with an increase in the over-all temperature difference, regardless of whether clean or rusty tubes were used. However, for the same temperature difference, the new tubes gave the higher coefficients, especially at the larger temperature differences, where variations in surface conditions would naturally exert a pronounced effect. Upon comparing these results with those obtained by substituting slightly dirty copper tubes, with the same tube arrangement as before, an additional improvement in the coefficients was found.

The copper tubes were then cleaned and polished, with the result that the coefficients were further increased, so that the heating surface had to be reduced to approximately 39 per cent of its previous value. Under these new conditions, the polished copper tubes gave higher coefficients than when slightly dirty. Upon cleaning these tubes with acid, still higher coefficients were observed. The following table gives the over-all coefficient, $U$, as B.t.u. per hour per sq.ft. per deg. F., all for an over-all temperature difference of 36 deg. F., with the boiling temperature held approximately constant at 167 deg. F.:

| Test Conditions | $U$ |
|---|---|
| 124 rusty steel tubes | 330 |
| 124 new steel tubes | 460 |
| 124 slightly dirty copper tubes | 1,000 |
| 48 polished copper tubes | 1,440 |
| 48 acid-cleaned copper tubes | 2,560 |

Additional experiments were made under various conditions, but the results just discussed clearly indicate the profound effect of surface conditions. The authors attribute the large percentage variations in

**Airplane View of the Bureau of Standards**

the coefficients for the copper tubes with different surface conditions, not so much to the thermal resistance of the almost imperceptible scale itself, but rather to the resistance of a film of water assumed to be entrapped by the scale.

While it is now impossible to offer general equations for use in evaporator design, these results are of considerable interest, in that they are so suggestive, both of possibilities for future improvements, and of explanations of discrepancies in the prior literature in the field of evaporator design.

*4. Heat Transfer in Enamel-Lined Equipment; E. P. Poste*—This paper reports quantitative values of the over-all coefficient of heat transfer in enamel-lined apparatus under various different conditions. Hitherto such quantitative data have not been available for the student of heat transfer. While it is still impossible to predict, by means of a general equation, the exact value to be expected under some new set of conditions, these results indicate that the qualitative effect of changing certain factors checks our present hypotheses of heat transfer. Hence in the future the estimation of capacities of this type of equipment will be less liable to error than in the past.

INSULATION AND HEAT LOSSES

*1. Loss of Heat From Furnace Walls; R. Calvert and Lyle Caldwell*—While the conductivity of a certain insulating brick is found to be the same by the box test and by the guard-ring method, the latter procedure is recommended. Conductivity-temperature charts are given for various insulators. For a certain insulating powder, the conductivity is greater at the higher densities, but this effect becomes less at the higher temperatures. Tests on a three-layer wall, each wall containing a different kind of brick, showed that the temperature gradient calculated from the known conductivities checked closely with the values actually indicated by thermocouples, the interfacial resistances being a small proportion of the total resistance. When one of the layers of brick was omitted, the heat loss was more than doubled.

*2. Heat Transfer From Bare and Insulated Pipes; R. H. Heilman*—Data are given for the heat loss from 1-in., 3-in. and 10-in. bare steam pipe. From these and other data the author derives tables from which one can readily determine the heat loss to a room at 70 deg. F. for various pipes ranging from ½ in. to 18 in. and for temperature differences up to 800 deg. F., this loss being expressed in various units.

Curves of thermal conductivity versus temperature are given for many commercial pipe coverings. The effect upon thermal conductivity of the covering, of porosity, void size, etc., is discussed in detail.

Data are given for the heat loss from the outer surface of pipe coverings, and a numerical example is solved to illustrate the method of calculating the heat loss from any given insulated pipe.

*3. Heat Transfer Through Building Walls; M. S. VanDusen and J. L. Finkelstein*—This paper is essentially a preliminary report of an investigation now in progress for the purpose of determining the rate of flow of heat through building walls. It contains very clear explanations of the complicated mechanisms by which heat flows from a heated room through the retaining wall to the colder outside air. The method consists of comparing the thermal resistance of an unknown panel with that of a standard panel, the resistance of which can be detrmined by other means which permit the measurement of heat under much more favorable conditions. The apparatus and operating procedure are described in detail, and results are given for four different types of commercial building walls.

*4. A Heat Transmission Meter; P. Nichols*—The heat meter under discussion consists of a thin board of cork or other material, about 2 ft. square, and provided with thermocouples to indicate the drop in temperature occasioned by the flow of heat through it when placed against a flat surface, such as floors, roofs and the walls of buildings, tunnels, etc. When calibrated, the extent of the drop in temperature is a measure of the heat current. While this heat meter has certain possibilities in connection with laboratory work, its primary use is said to be in determining the rate of heat flow occurring under natural conditions.

An application of one of the meters to a 24-in. brick wall revealed a larger percentage variation in the heat current than was expected. A preliminary determination of the thermal conductivity of a 24-in. concrete wall under natural conditions gave a value of "about 12 B.t.u. per sq.ft. per hour per deg. F. per inch of thickness, as compared with the usually accepted value of 8.7 obtained from laboratory tests." The author believes that the conductivity of commercial walls will usually be found to be greater than that indicated by laboratory determinations, due to differences in density, moisture content, etc.

An additional paper, not considered in Mr. McAdams' review, was given by Enoch Karrer and A. Poritsky. This paper was entitled "The Transference of Heat From and to Fine Wires, and Some Applications." It comprised a general review of the subject, a bibliography, a study of the mechanism of heat transfer at the wire boundary and a study of the characteristics of various alloy wires, together with an account of many possible applications of fine wires as media of heat transfer.

## Shipping Turpentine Presents Difficulties

A turpentine producer recently brought to the attention of the Bureau of Chemistry the trouble he was having with shellacked tank cars in which he shipped turpentine. One car that had been recently shellacked was loaded with turpentine and shipped to New York. On arrival, the turpentine was discolored and the shellac was found to be peeling off, making it necessary to shellac the tank again and to sell the turpentine at a discount.

A sample of the shellac was examined by the Bureau of Chemistry, with the following results:

| | Per Cent |
|---|---|
| Solvent (90 per cent denatured alcohol) | 60.7 |
| Solids (shellac and rosin) | 39.3 |
| Rosin (calculated on basis of solids) | 15.0 |

The shellac was bleached, which is not as suitable for this purpose as is orange shellac. The results show that the shellac was adulterated with 15 per cent of rosin. This material when applied as a test to clean boiler-plate iron, dried, suspended in turpentine, and subsequently dried again, was slightly tacky and could be scratched off with the finger nail, while a coating of pure shellac tested in the same way was hard and dry and could not be scratched off.

# Final Report on Oppau Disaster

**Practice of Blasting Fertilizer Salt From Storage Piles Held Responsible for Explosion**

SUPPLEMENTING the discussion on the explosibility of ammonium nitrate in the April 21 issue of *Chem. & Met.* are the conclusions of Committee 34 on the Oppau disaster, presented below in abstract from the report of H. Kast, *Chemiker-Zeitung*, March 13 and 20, 1924, pp. 133-5 and 158-60.

This report closes the official investigations of the causes of the explosion of fertilizer salt at the Oppau plant of the Badische Anilin- und Sodafabrik, Sept. 21, 1921.

Fertilizer salt is either a mixture or a double salt of $NH_4NO_3$ and $(NH_4)_2SO_4$. The mixture is explosive; the double salt is not. The commercial product cakes when stored, and the custom was to break it up with blasting cartridges.

A charge of criminal negligence against the Badische company, on the grounds that the wage plan encouraged hasty work resulting in insufficient mixing by the workmen, was found to have no basis in fact.

The findings of the committee support the prevailing opinion that the explosion was due to a blasting charge in the ordinary procedure of breaking up the salt. The possibilities considered, and the conclusions reached, are as follows:

1. *Use of an unusually powerful explosive for blasting.* The evidence indicates that the usual material (perastralite) was used and that the charge was not unusually large.

2. *Detonation of normal fertilizer salt by a stronger explosive or a larger charge than usual.* A small quantity of normal fertilizer salt can be detonated by perastralite, but not a large quantity, because the salt is not sensitive enough to propagate the explosion. A salt containing as high as 70 per cent $NH_4NO_3$ cannot be completely detonated even with picric acid. Any accidental use of a charge of unusual character is precluded by the fact that the blasting cartridges issued on the day of the explosion were part of a large shipment which had been giving perfect satisfaction. On the preceding day at least thirteen shots of seventeen cartridges (from the same lot) had been fired.

3. *Detonation of physically or chemically abnormal fertilizer salt by a stronger or larger charge than usual.* Under certain conditions pure $NH_4NO_3$ can be completely detonated by perastralite; but many experiments have failed to show a complete detonation of the double salt $2NH_4NO_3.(NH_4)_2SO_4$; and more than 30,000 shots had been fired at the Oppau works before the disaster. A mixture in the same ratio is more sensitive, however, than the double salt; and it has been shown that detonation is favored when the nitrate is finely powdered and the sulphate is coarse. Unusual dryness and high temperature also favor detonation. A well-tamped or compressed blasting charge, or a loose mass of salt, would increase the danger of explosion.

4. *Presence of abnormal fertilizer salt.* The analytical records indicate that the composition of the salt which exploded was quite as usual. A separation might have occurred in the spraying process; but the sampling in the neighborhood of the sprayer seems to have been such that this would have been detected. The theory that the dust from the sprayer, as it spread, may have become richer in $NH_4NO_3$ due to more rapid settling of the sulphate is highly improbable, because a high temperature would be required to decompose the double salt (it is only about half decomposed when spraying at 70 deg. C.), whereas the spraying was done at room temperature. It is barely possible that in the 3 months the sprayer had operated there might have been a sufficient accumulation of powder relatively rich in $NH_4NO_3$ to cause the explosion; but in view of the moist atmosphere of the spraying room and the moderate spraying temperature, this is very improbable.

There seems also to have been nothing unusual in the physical nature of the salt; humidity and temperature were normal, and so was the highly important compactness of the salt. There is, however, the possibility that the blasting cartridges chanced to find a pocket of loose salt between layers of compacted salt. There is no evidence that a physical separation into fine $NH_4NO_3$ and coarse $(NH_4)_2SO_4$ had occurred; but if a rise in the spraying temperature or pressure did bring about such a condition, other circumstances favoring the explosive tendency may have combined with this to cause the disaster.

This, though improbable, is the strongest of the possibilities reviewed.

5. *Some cause entirely different from the blasting.* The fact that seismographic records and other evidence indicated two explosions 4 seconds apart, the first involving 50 to 60 tons of fertilizer salt and the second involving 300 to 400 tons, was thought by some to indicate some other cause than blasting. There was certainly no gas explosion, however, and the evidence shows that both explosions were of solid salt, of which the main mass (about 3,000 tons) stopped the propagation of the decomposition of the two relatively smaller portions. It is believed that the sheet of flame which accompanied the smaller first explosion promoted the detonation of the second mass. This does not explain why the first explosion did not scatter the entire remainder of the mass, nor how it was able to decompose the poorly conducting and non-sensitive salt sufficiently to cause the second explosion in 4 seconds. But all the other explanations involve even greater difficulties.

The conclusion is that the disaster was caused by blasting, and that this method of breaking up solid materials containing nitrates should be forever abandoned. There is no other source of danger in the manufacture and transportation of fertilizer salt, even though an unusual concentration of nitrate should occur.

## Poland's Petroleum Industry

The crude oil production of Poland in 1923 amounted to 737,187 tons. After deducting the crude oil burned on the fields, etc., net production was 632,032 tons. Respective figures in 1922 were 713,301 tons and 590,090 tons. These figures show that the production of crude oil last year, in comparison with 1922, has increased by 24,086 tons—that is, 3.38 per cent. Replacing crude oil by coal and gas, and also through general economy, 25,338 tons of crude oil was saved. This amount has increased the quantities of crude oil used for refining purposes. The crude oil production in 1923 would have been at least 10,000 tons larger were it not for a strike on the fields in the first half of November last year, which lasted for a week. The increase in the production of crude oil after a constant fall which lasted since 1910 is considered encouraging.

# Fixed Nitrogen
# A National Economic Problem

## Commanding Importance of Nitrogen Compounds Revealed by Statistics of Export, Import, Distribution and Consumption

By Harry A. Curtis
Special Agent, Bureau of Foreign and Domestic Commerce, and Professor of Chemical Engineering, Yale University

> Part II of the Nitrogen Survey attempts to assemble and correlate the essential facts of the nitrogen situation as it exists in the United States. The first section of the Nitrogen Survey report, recently published, dealt specifically with the cost of producing and marketing Chilean nitrate and the possible variations that might be expected in each of the factors which determine the cost of this material. The present section presents a more general review of the nitrogen situation and shows the place that Chilean nitrate holds in supplying the nitrogen needs of the nation. Particular attention is given to domestic sources of nitrogen supply, with the idea of ascertaining to what extent domestic production may be relied upon to meet the requirements in the near future. Since the present section is more in the nature of a general review of the situation, based primarily on statistical data, it has been thought best to reserve for a later section the technical discussion and cost data for the air-nitrogen processes.
>
> Julius Klein,
> *Director, Bureau of Foreign and Domestic Commerce*

THE domestic supply of fixed nitrogen is practically all accounted for in the byproduct ammonia nitrogen of the coal-processing industries and the "organic ammoniates" such as cottonseed meal, tankage, etc. The nitrogen fixed by the newly established air-nitrogen industry is as yet small in amount. Of our domestic byproduct nitrogen production, we are now exporting roughly one-third; the remainder is split between industries and agriculture, the great bulk going to agriculture. Of the "organic ammoniates" produced, a small percentage is exported in nitrogenous fertilizers, and a considerable quantity is used in manufacture of mixed fertilizers for domestic consumption. The bulk of this kind of material, however, is being used as live-stock feed and is thus removed from the scope of our survey.

Of the foreign sources of nitrogen drawn upon by the United States, Chilean nitrate is the largest by far. This nitrate is divided about evenly between industries and agriculture, the latter taking a little more, perhaps 60 per cent of the total. Aside from Chilean nitrate, we import in round numbers 50,000 tons of cyanamide from Canada, a few thousand tons of Norwegian nitrate, and a few thousand tons of "organic ammoniates," such as dried blood from South America, guano from Peru, etc. These materials are imported primarily for their contained nitrogen, and are therefore of interest in a nitrogen survey. Our import records reveal that numerous nitrogen-containing chemicals are imported in relatively small quantities. In most cases these chemicals are not used primarily because of the nitrogen in them, but because individual properties of the particular salt are of specific value to an industry. This fact must be constantly in mind in dealing with nitrogen data from the standpoint of the industries.

For agricultural purposes there are cases where Chilean nitrate has a small advantage over ammonium sulphate and vice versa, but they are essentially alike in behavior. In the industries there is probably not a case where one of these salts might be substituted for the other. Even in the problem of supplying agricultural nitrogen, the question of the kind of fixed nitrogen cannot be disregarded entirely. For example, cyanamide nitrogen no doubt becomes available as a plant when placed in the soil. Calcium cyanamide, however, possesses certain undesirable qualities, and the natural advantage of cheapness which cyanamide nitrogen enjoys is thus in a measure offset.

There is another point, somewhat related to the above discussion, that is particularly significant at present. There appears to be rather a general consensus of opinion among nitrogen technologists at present that, given cheap power, ammonia can be produced by some of the direct synthetic processes at about 5 cents per pound. This is only about half the price of ammonia in ammonia liquor and one-third the price of nitrogen in Chilean nitrate. While this estimate as to cost of synthetic ammonia production is probably somewhat optimistic, it undoubtedly is qualitatively correct. Ammonia itself is a gas, however, and not a fertilizer material; before it can be marketed as a fertilizer it must be combined with some sort of a carrier, such as sulphuric acid, commonly used, or phosphoric acid, which may some day be used. Having cheap ammonia, it does not follow as a matter of course that cheap fertilizer will at once become available. It is hoped that fertilizers can in time be produced and sold at half present prices, because of the obvious benefit that would accrue to

This article is the first of a series of four excerpts from Part II of the Nitrogen Survey. Part I was published in January and abstracted in *Chem. & Met.*, Jan. 7, 1924.

**Table I—Imports* Entered for Consumption†**

(Calendar years. Net tons of 2,000 lb. each)

| Material | 1919 Material | 1919 Nitrogen | 1920 Material | 1920 Nitrogen | 1921 Material | 1921 Nitrogen | 1922 Material | 1922 Nitrogen |
|---|---|---|---|---|---|---|---|---|
| Ammonia and liquor | ....... | ...... | 13 | 3 | ....... | ...... | 53 | 11 |
| Ammonium carbonate and bicarbonate | 74 | 18 | 149 | 37 | 275 | 69 | 348 | 87 |
| Ammonium chloride | 1,005 | 262 | 3,350 | 871 | 2,378 | 618 | 3,850 | 1,001 |
| Ammonium nitrate | 255 | 89 | 14,238 | 4,983 | 25,082 | 8,779 | 11,985 | 4,195 |
| Ammonium perchlorate | 59 | 7 | 1,729 | 207 | 2,634 | 316 | 134 | 16 |
| Ammonium phosphate | ....... | ...... | 6 | 1 | 7 | 1 | 48 | 10 |
| Ammonium sulphate | 2,626 | 541 | 2,232 | 460 | 5,238 | 1,079 | 5,524 | 1,138 |
| Blood dried | 5,500 | 660 | 7,263 | 872 | 4,992 | 599 | 10,261 | 1,231 |
| Potassium cyanide | 588 | 118 | 7,224 | 1,445 | 1,886 | 377 | 1,544 | 309 |
| Potassium nitrate, crude | 18,826 | 2,447 | 18,816 | 2,446 | 8,297 | 1,179 | 2,731 | 355 |
| Potassium nitrate, refined | 37 | 5 | 631 | 87 | 670 | 92 | 513 | 71 |
| Potassium ferrocyanide | 258 | 52 | 381 | 76 | 224 | 45 | 229 | 46 |
| Potassium ferricyanide | 17 | 4 | 51 | 13 | 13 | 3 | 38 | 9 |
| Sodium cyanide | 2,587 | 647 | 3,795 | 949 | 4,354 | 1,089 | 7,853 | 1,963 |
| Sodium nitrate | 456,466 | 71,209 | 1,480,519 | 230,761 | 424,674 | 66,249 | 607,560 | 94,779 |
| Sodium nitrite | 1,275 | 252 | 5,845 | 1,169 | 1,587 | 317 | 731 | 146 |
| Sodium ferrocyanide | 650 | 72 | 1,101 | 121 | 1,255 | 138 | 2,070 | 228 |
| Urea | 7 | 3 | 12 | 6 | 18 | 8 | 130 | 61 |
| Explosives, fireworks, etc. | 7,061 | 1,059 | 2,212 | 332 | 2,510 | 377 | 2,237 | 336 |
| Calcium cyanamide | 69,576 | 13,915 | 79,868 | 15,974 | 18,028 | 3,606 | 46,824 | 9,365 |
| Guano | 7,859 | 786 | 60,245 | 6,025 | 1,961 | 196 | 14,568 | 1,457 |
| Other nitrogenous fertilizers | ....... | ...... | ....... | ....... | ....... | ...... | 26,302 | 2,630 |
| Calcium nitrate | ....... | ...... | ....... | ....... | ....... | ...... | ‡1,229 | 160 |
| Pyridine and quinoline | 83 | 11 | 432 | 56 | 36 | 5 | 60 | 8 |
| Nitrobenzol | 26 | 3 | 23 | 3 | ....... | ...... | ....... | ....... |
| Nitric acid | ....... | ...... | 24 | 3 | ....... | ...... | 46 | 6 |
| Total nitrogen | ....... | 92,160 | ....... | 266,900 | ....... | 85,142 | ....... | 119,618 |

* The term "Imports Entered for Consumption" includes articles entered for immediate consumption and imported articles withdrawn from warehouses for consumption. These figures will differ from the general import figures to the extent that the entries to warehouses differ from the withdrawals from warehouses.
† Table does not include nitrogenous dyestuffs, intermediates, medicinals, miscellaneous organic nitrogen chemicals.
‡ Record begins Sept. 22, 1922.

agriculture and therefore to the general welfare of the country. That such a result can be secured by some sort of sudden magic is not within the range of possibility. Fixed nitrogen in some forms at half present prices seems not altogether remote, but there is a long and difficult road between this point and large tonnages of fertilizer delivered to the farmers at half price. Millions of dollars must be spent in research, in development of manufacturing processes, in educational work, before the goal is reached. It is beginning to appear, however, that the manufacturing of fertilizers presents an unusual opportunity for development of new processes and for business enterprise.

### Analysis of Imports and Exports

While Chilean nitrate is our chief import of fixed nitrogen, and ammonium sulphate our chief export of fixed nitrogen, other nitrogenous materials are imported and exported in amounts which, while relatively small, should be considered in arriving at a figure for total nitrogen requirements of the nation. Table I indicates our imports and their estimated nitrogen equivalent, and Table II sets up corresponding data for exports. The basis of classification for import and export materials has been changed several times by the government, and it is not possible to get very accurate data. Also it must be noted that only rough estimates can be made as to the nitrogen content of materials listed as "nitrogenous fertilizers" and as "dynamite, powders, etc." The effect of any error made in these estimates is, however, obviously small in considering the total nitrogen imported and exported by the United States.

The distribution of the ammonium sulphate exported by the United States is given in Table III. Before the World War the fertilizer industries in this country absorbed the domestic production of ammonium sulphate and a considerable tonnage was imported. There was a rapid development of our byproduct coke industry during and following the war, with corresponding increase in sulphate production. The fertilizer industry, however, has not yet reached pre-war production, and has not absorbed the increase in production of sulphate. The great slump in British production of sulphate during 1921-22 gave an opportunity for American

**Table II—Exports of Nitrogenous Material***

(Calendar years. Net tons of 2,000 lb. each)

| Material | 1919 Dom. | 1919 For. | 1920 Dom. | 1920 For. | 1921 Dom. | 1921 For. | 1922 Dom. | 1922 For. |
|---|---|---|---|---|---|---|---|---|
| Ammonium chloride | ..... | ..... | ..... | 4 | ..... | 32 | ..... | 21 |
| Nitrogen, 26.1% | ..... | ..... | ..... | 1 | ..... | 8 | ..... | 6 |
| Ammonium sulphate | ..... | 68 | † 66,714 | 38 | 114,928 | 227 | 163,011 | 837 |
| Nitrogen, 20.6% | ..... | 14 | 13,743 | 8 | 23,675 | 47 | 33,580 | 172 |
| Ammonia and compounds | ..... | ..... | ..... | ..... | ..... | ..... | 3,624 | ..... |
| Nitrogen, 40% | ..... | ..... | ..... | ..... | ..... | ..... | 1,450 | ..... |
| Cyanamide | ..... | ..... | ..... | ..... | ..... | ..... | ‡47 | 83 |
| Nitrogen, 20% | ..... | ..... | ..... | ..... | ..... | ..... | 9 | 17 |
| Explosives, gunpowder, etc. | 8,963 | ..... | 29,775 | 1 | 5,217 | ..... | 9,606 | ..... |
| Nitrogen, 15% | 1,344 | ..... | 4,466 | ..... | 783 | ..... | 1,441 | ..... |
| Nitric acid | 251 | ..... | 358 | ..... | 89 | ..... | 338 | ..... |
| Nitrogen, 14% | 35 | ..... | 50 | ..... | 12 | ..... | 47 | ..... |
| Nitrogen fertilizers | ..... | ..... | ..... | ..... | ..... | ..... | 1,765 | ..... |
| Nitrogen, 10% | ..... | ..... | ..... | ..... | ..... | ..... | 177 | ..... |
| Potassium cyanide | ..... | ..... | ..... | ..... | ..... | 1 | ..... | 145 |
| Nitrogen, 20% | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 29 |
| Potassium nitrate | ..... | 143 | ..... | ..... | ..... | 226 | ..... | 44 |
| Nitrogen, 13% | ..... | 19 | ..... | ..... | ..... | 29 | ..... | 6 |
| Sodium cyanide | ..... | ..... | ..... | 78 | ..... | 703 | 624 | 82 |
| Nitrogen, 25% | ..... | ..... | ..... | 20 | ..... | 176 | 156 | 21 |
| Sodium nitrate | ..... | 15,314 | ..... | 22,197 | ..... | 37,027 | ..... | 14,601 |
| Nitrogen, 15.6% | ..... | 2,361 | ..... | 3,463 | ..... | 5,776 | ..... | 2,278 |
| Total nitrogen | 1,379 | 2,394 | 18,259 | 3,492 | 24,470 | 6,036 | 36,860 | 2,529 |

* Items of less than 1 ton omitted.
† Record begins May 1.
‡ This must be an error, since no cyanamide was made in the United States except at U. S. Nitrate Plant No. 2.

producers to reach foreign markets ordinarily supplied by Europe. With normal production of iron, and therefore of sulphate, in Europe, many of these markets will necessarily be recaptured by foreign producers. The American producer has a large potential market for ammonium sulphate at home, and need not meet competition for foreign markets below the price at which the domestic market will absorb the total output. However, the United States will no doubt be able to hold some of the foreign markets where it has a natural geographic advantage. There are indeed producers of sulphate who believe that the export market will enable them to avoid competition with air-nitrogen products, should the nitrogen-fixing industry develop in this country. There does not appear to be good ground for this belief, but it is probable that a rapid development of an air-nitrogen industry in this country would force sulphate to seek an export market for the reason that the air-nitrogen industry will certainly produce nitrogen-carrying materials better adapted for fertilizer use than is ammonium sulphate. If cheap phosphoric acid becomes available presently, this may replace the sulphuric acid now used to collect byproduct ammonia in coke plants, and this will give the byproduct nitrogen a better chance to compete with the synthetic nitrogen compounds.

**Table III—Distribution of Domestic Exports of Ammonium Sulphate**

(Net Tons of 2,000 Lb. Each)

| Country | 1920 May 1-Dec. 31 | 1921 | 1922 |
|---|---|---|---|
| Austria | ...... | ...... | 721 |
| Azores and Madeira Islands | ...... | 25 | ...... |
| Greece | 312 | 324 | 398 |
| Italy | ...... | 114 | 819 |
| Netherlands | 49 | ...... | 1,007 |
| Spain | 9,005 | 3,947 | 27,449 |
| Canada | 84 | 11 | 213 |
| Salvador | 11 | 13 | 26 |
| Mexico | 102 | 63 | 60 |
| Trinidad and Tobago | 2 | 475 | 351 |
| Other British West Indies | 54 | ...... | 394 |
| Cuba | 14,806 | 3,873 | 2,292 |
| Dominican Republic | 6 | ...... | 1 |
| French West Indies | 878 | 264 | 2,401 |
| Haiti | 2 | ...... | ...... |
| Argentina | 46 | ...... | 9 |
| Brazil | 11 | ...... | 5 |
| British Guiana | 545 | 395 | 20 |
| China | ...... | 50 | 291 |
| British India | ...... | 22 | ...... |
| Straits Settlements | 91 | ...... | ...... |
| Dutch East Indies | 32,262 | 23,809 | 21,189 |
| Hongkong | 72 | 820 | 6,214 |
| Japan | 8,145 | 77,112 | 74,825 |
| Australia | 44 | 340 | 500 |
| New Zealand | ...... | 2,658 | ...... |
| French Oceania | ...... | 2 | ...... |
| Philippines | 176 | 49 | 4,865 |
| British West Africa | ...... | 231 | ...... |
| Canary Islands | ...... | 329 | 1,218 |
| England | ...... | ...... | 30 |
| Guatemala | ...... | ...... | 7 |
| Barbados | ...... | ...... | 20 |
| Chile | ...... | ...... | 5 |
| French Guiana | ...... | ...... | 1 |
| Totals | 66,703 | 114,927 | 147,331 |

### A Fixed Nitrogen Balance Sheet

In order better to visualize the status of fixed nitrogen in the United States it is possible to set up a form of balance sheet and, though the necessary data are lacking for a strictly quantitative account, it is instructive to consider the items of the account and to discuss their approximate weights.

The following is suggested as a make-up for an ideal account:

*Debits:*

Item *A*. Balance of fixed nitrogen brought forward at beginning of period.
" *B*. Fixed nitrogen recovered from coal processing.
" *C*. Fixed nitrogen produced by air-nitrogen industry.
" *D*. Total fixed nitrogen imports.
" *E*. Nitrogen fixed in soil by bacteria.
" *F*. Fixed nitrogen carried into soil by rainfall.
" *G*. Incidental entries of fixed nitrogen.

*Credits:*

Item *H*. Total fixed nitrogen exports.
" *I*. Nitrogen returned to the air through bacterial and chemical actions.
" *J*. Incidental losses of fixed nitrogen.
" *K*. Balance on hand at end of period.

Obviously, the sum of the debit must equal the sum of the credit items, for nitrogen, like other matter, is not created or destroyed. The items listed require some explanation, however.

*Item A*—This item includes all fixed nitrogen within the country at the initial moment of the period under consideration. It includes all fixed nitrogen accumulated in the soil, in plants, in living animals, in foodstuffs on hand, etc. It includes the inventory of all the nitrogenous chemicals on hand at the time. The free nitrogen of the air is not included, nor is the fossil nitrogen in coal, peat, oil or oil shale deposits. There is, of course, no way of arriving at even an approximate estimate of the quantity of nitrogen involved in Item *A*, nor of Item *K*, which is the corresponding total fixed nitrogen in the country at the end of the period under consideration. The difference between Item *A* and Item *K* tells what is happening to our fixed nitrogen account, however; and this difference is, of course, the same as the sum of Items *B* to *G* inclusive, minus the sum of Items *H* to *J*, inclusive.

*Item B*—The fixed nitrogen recovered from coal is not included in the reserve on hand at the beginning of the period, since the nitrogen in coal must be mined and brought into the active region under consideration, just as the free nitrogen of the air must be "fixed" before it enters as a debit. Elsewhere in this report it has been estimated that approximately 98,900 tons of nitrogen was recovered from coal in the United States during 1922.

*Item C*—The quantity of fixed nitrogen produced by nitrogen-fixing plants in this country is as yet small, but will no doubt become considerably larger during the next decade. It has been estimated that the total fixed nitrogen available from this source during 1922 was 3,100 tons.

*Item D*—The total imports of fixed nitrogen for 1922 may be taken as 119,618 tons, about 80 per cent of this being represented in the Chilean nitrate imported. This item should include the fixed nitrogen imported in foodstuffs, but data are lacking.

*Item E*—Since the total land area of the United States is involved here, there are no data available. If we assume that there is very little change in the nitrogen content of the soil due to bacterial activity where there is no cultivation of the soil, then we may take the very rough, estimated value for Item *E*—namely, 2,750,000 tons.

*Item F*—The amount of fixed nitrogen carried down by rainfall is taken as 5 lb. per acre per year. Over the whole land area of the country the average would be less than this, since the annual rainfall is higher over the cultivated area than the average for the whole

country. There is no way of arriving at an estimate of any real significance, but since the fixed nitrogen in the unimproved land of the country is not so important as that in the cultivated area, the value of Item *E*—namely, 750,000 tons per year—is probably significant.

*Item G*—This item includes all incidental entries of fixed nitrogen not covered by Item *D*. The fish scrap used for fertilizer and live-stock food is an example. Another addition, which it seems quite absurd to include but which is really one of considerable size, is fixed nitrogen in human form which enters the country annually through Ellis Island and similar stations.

*Item H*—Table II estimates the exportation of fixed nitrogen at 39,389 tons for 1922. Here again the fixed nitrogen in foodstuff exports is not included.

*Item I*—There are no data of any sort for evaluating this item for the whole area of the country. For the cultivated area the best data indicate an annual loss of 3,750,000 tons, most of which must be accounted for by eventual return of nitrogen to the air and by export of fixed nitrogen in foodstuffs.

*Item J*—Whatever nitrogen is carried into the ocean by rivers would be included here. Most of the fixed nitrogen leached from the soil must soon be returned to the air, however, since the nitrogen content of river waters and of the ocean is small. Item *J* is apparently less than the corresponding Item *G*.

It is evident from the above considerations that data are not available to make a balance sheet that will contain every appropriate item. There is so much uncertainty in the enormous quantities of nitrogen exchanged between the soil and the air by natural bacterial and chemical means that any attempt to include these with the known but relatively small amounts handled by human agencies necessarily destroys the quantitative significance of the known data.

### Data on Total Consumption of Inorganic Nitrogen in United States

The consumption of inorganic nitrogen in the United States may be estimated by the familiar formula:

*Consumption = Production + Imports — Exports*

and the terms of the equation evaluated as follows for the year 1922:

| Production | Net Tons of Fixed Nitrogen |
|---|---|
| From coal distillation | 98,900 |
| From bone distillation | 200 |
| From the air | 3,100 |
| Imports (omit "dried blood," "guano," etc., Table I) | 116,861 |
| | 219,061 |
| Exports (Table II) | 39,389 |
| Consumption | 179,672 |

The above tonnage of fixed nitrogen, say 180,000 tons, is equivalent to about 900,000 tons of ammonium sulphate or about 1,154,000 tons of Chilean nitrate. These figures apply to 1922. It is known that the corresponding figures for 1923 are considerably higher, the total inorganic nitrogen consumed probably being in the neighborhood of 260,000 tons.

### Additional Consumption of Nitrogen in Organic Forms

It should be noted that the above data on nitrogen consumption do not include the "organic ammoniates" used in the fertilizer industry. Of these about 10,460 tons of nitrogen in the form of cottonseed meal went into fertilizer. The nitrogen in the total fish scrap produced was in the neighborhood of 7,500 tons, of which perhaps 5,000 tons was used in fertilizers. The fixed nitrogen from animal tankage going into fertilizer was probably about 2,000 tons, from garbage tankage about 2,000 tons, and from miscellaneous nitrogenous scrap probably 15,000 tons. The items of dried blood and guano would add 2,688 tons of organic nitrogen.

The use of organic nitrogenous materials in fertilizers is in a state of flux and, in general, the quantity of such used is decreasing. The above estimates are all very rough, and in view of the changing conditions a closer survey is probably not justified. If we add the items estimated above, the fixed nitrogen supplied by these organic sources is evidently about 34,500 tons, and the total consumption of nitrogen in all forms in the United States was apparently in the neighborhood of 220,000 tons in 1922, and 300,000 tons in 1923.

## Artificial Wood a Commercial Possibility

Howard F. Weiss, who described balsaam-wool in *Chem. & Met.* of Sept. 17, 1923, writes of this material in the current issue of the *Scientific American*, and goes on to describe another development of the same nature.

This product, to which the trade name nu-wood has been given, is a dense solid mass of tree fibers pressed together into boards 4 ft. wide by 16 ft. long and varying in thickness from $\frac{1}{8}$ to $\frac{3}{8}$ in. These large boards are then resawed into smaller boards of any size desired. Since the process starts with the individual fiber just as in the paper industry, it is possible to use the natural wood in any form or size whatever. In fact, the process uses sizes and forms of wood even too small and crooked to be ordinarily profitable to the paper maker; thus slabs, edgings, sawdust, trimmings, etc., make an ideal raw material for the manufacture of nu-wood and from them is made a finished product which can be sawed, nailed, sanded and finished like natural lumber, but with the added advantage that it warps less and has no defects such as knots, shakes, pitch pockets, worm holes, etc. In the lumberman's vernacular, nu-wood is all "F A S" or clear on all sides.

In the manufacture of nu-wood the sawmill offal is first chipped to small particles and is then treated with an alkaline solution, but not to the same degree as in the manufacture of balsaam-wool. The alkaline treated chips are then ground mechanically in the presence of water, so that they are torn to pieces and the structure of the individual cells in many cases is completely destroyed. In this condition they are sized to render them waterproof and are then flowed in a current of water on to a screen and subjected to heavy pressure to force out the water. The pressure reduces the mass of fibers to a stiff board-like cast of wood, which is then subjected to heat so that the remaining moisture is reduced to about 6 or 8 per cent. The final result is a stiff, strong, dense board of wood fibers, so intermingled and interlocked that the synthetic product has none of the grain characteristic of natural wood.

Nu-wood is designed to compete with lumber for such purposes as furniture cores, boxes, wood trim, panel stock, etc. It takes paint as well as natural wood and as it holds glue most tenaciously, it makes an excellent base for veneer stock.

# Corrosion-Resisting Alloys and the Mechanism of Corrosion

### Important Contributions to the Literature on These Subjects Presented at Joint New York Meeting of Four Technical Societies

A JOINT meeting of sections of the Society of Chemical Industry, American Chemical Society, American Electrochemical Society and the Société de Chimie Industrielle was held at the Chemists Club, New York City, on Friday evening, April 18. Corrosion and corrosion-resisting metals provided topics for two authoritative papers and for some general discussion.

The paper "Fundamental Factors of Corrosion," by Walter G. Whitman, discussed corrosion theory and presented a picture of the mechanism of corrosion as it is now accepted by the adherents of the electrochemical theory of corrosion. Mr. Whitman presented proofs of this theory and refutations of other theories with such completeness that most of them must be omitted from the accompanying abstracts for lack of space.

Dr. B. D. Saklatwalla talked on "Ferrous Alloys Resistant to Corrosion," with particular attention to the "stainless" steels and irons. In discussing their application in chemical engineering fields and future methods of production he presented much information that has not hitherto been general knowledge.

## Fundamental Factors of Corrosion

**By Walter G. Whitman and R. P. Russell**
Department of Chemical Engineering, Massachusetts Institute of Technology

The electrochemical explanation of corrosive action was quite generally accepted soon after its formulation by Whitney (see *J. Am. Chem. Soc.*, 1903, vol. 25, p. 394) and its early development by other investigators. In more recent years this concept has been severely attacked by proponents of other theories, notably those of direct oxidation and of catalytic colloidal action. (See Bengough, Sixth Report Corr. Res. Comm. Inst. of Metals, 1922, and Friend, *Carnegie Memoirs Iron & Steel Inst.*, 1922, vol. 11.) The weight of experimental evidence, however, strongly indicates that corrosion is fundamentally electrochemical in nature and that the processes can best be explained along electrochemical lines. Certain modifications of the earlier ideas are necessary and the investigations of men who have attacked the electrochemical theory have assisted in clearing up many points and in bringing out the picture we have at present.

According to this picture the initial reaction in the submerged corrosion of iron is electrochemical and operates through a corrosion cell. At the anodic electrode of this cell the corroded metal sends ferrous ions into solution according to the reaction

$$Fe + 2(+) = Fe^{++} \qquad (1)$$

A corresponding reduction occurs at the cathode area, usually the deposition of hydrogen ions as atomic hydrogen or the solution of dissolved oxygen to form hydroxide ions. While these two are the most common cathode reactions, there are a number of other possible reductions, such as the deposition of copper, the solution of dissolved chlorine to form chloride ions and the reduction of nitric acid. The cathode reaction for hydrogen deposition may be expressed as:

$$2H^+ = 2H + 2(+) \qquad (2)$$

and for oxygen solution, as:

$$\tfrac{1}{2}O_2 + H_2O = 2OH^- + 2(+) \qquad (3)$$

It should be noted that the oxygen effect has usually been expressed as a depolarization of the atomic hydrogen formed by reaction 2. The authors themselves have used Wilson's equations (*Ind. Eng. Chem.*, 1923, vol. 15, p. 127) in earlier papers, but now believe that reaction 3 expresses the facts in a more direct and convenient form, and that dissolved oxygen takes part in the direct cathode reaction, rather than that it serves as a depolarizer for atomic hydrogen as postulated by Wilson and others.

The rate of corrosion under natural waters is determined by the rate of oxygen diffusion to an effective cathode surface and by the protectiveness of the film formed on the metal. Films of corrosion products exert a more or less protective action which depends primarily upon the conditions attending their formation. Even the ordinary rust formed on iron by natural waters exhibits some degree of protectiveness, and certain waters build up more resistant layers than do others. The thickness of such rust films beyond a certain thin limit is a comparatively unimportant factor, whereas the solubility, density and adherence to the metal are vital characteristics. Thus in alkaline solutions, the reason for reduced corrosion is the greater film protectiveness due to decreased solubility of the rust. The effect of neutral salts in the water, while not yet fully understood, is undoubtedly attributable to their action on protective films.

A factor that has not received proper appreciation in studies of corrosion is the possibility of a difference in the compositions of the solution in direct contact with the surface of the corroding metal and the main solution itself. Thus, the corrosion of iron in natural water forms a rust that is highly oxidized to the ferric state on the outside but that consists of ferrous hydroxide in the inside layers adjacent to the metal. Now ferrous hydroxide is slightly soluble, and because of this solubility, a saturated solution of ferrous hydroxide is somewhat alkaline and has a $p_H$ value of about 8.5.

The corrosion of steel by natural waters containing dissolved oxygen is found to be independent of the hydrogen-ion concentration (of the main solution) over a considerable range. Thus the $p_H$ value of a given natural water saturated with oxygen can be varied

from about 10 to 4.5 at room temperature by adding sodium hydroxide or hydrochloric acid and the corrosion rate will be unchanged by these variations in acidity. (See Fig. 1.) The constancy of corrosion rate with varying $p_H$ is explained by the fact that the $p_H$ of the liquid against the metal remains practically constant, and the conditions at this point and therefore the film protectiveness are independent of the $p_H$ in the main solution over this range.

### Several Factors Affect Oxygen Diffusion

Since the film protectiveness is maintained constant over the entire natural water range, the rate of corrosion in any given natural water is determined by the rate of oxygen diffusion alone. The composition and surface structure of the iron or steel are of practically no importance, and all commercial steels corrode at the same rate. The work of Hadfield, Richardson and others has experimentally demonstrated this point.

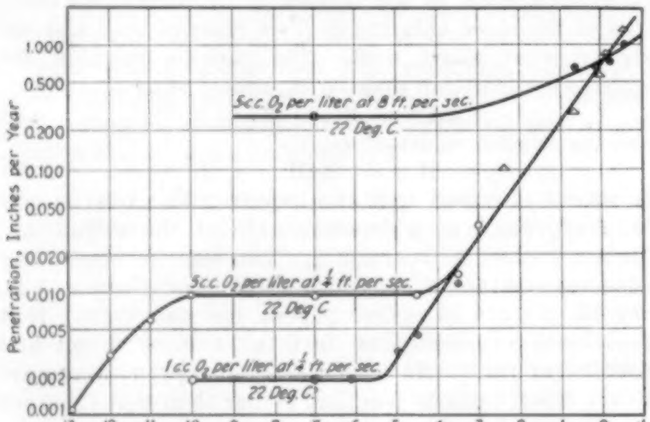



**Fig. 1—Rate of Corrosion of Steel vs. Hydrogen-Ion Concentration**

The position of the curve varies with variation in oxygen concentration or the velocity with which the solution passes the specimen.

The factors controlling oxygen diffusion in any given water (the film protectiveness being constant) are oxygen concentration, velocity and temperature. The diffusion rate is directly proportional to the oxygen concentration and this is the most important factor in the problem.

The effect of velocity in natural water corrosion is to increase the rate of oxygen diffusion by thinning down the layer of fairly quiet liquid against the surface through which the oxygen must diffuse. Speller's data on this point are in fair agreement with data on the effect of velocity in heat transfer.

Further work by the writers has resulted in the following additional conclusions:

1. In non-oxidizing acids hydrogen gas is evolved and the rate of corrosion by this means is largely affected by overvoltage. For this reason, the composition and surface condition of the metal are important factors. Corrosion by dissolved oxygen in acids is limited by the rate of oxygen diffusion to the surface of the metal as in natural waters. The oxygen effect becomes pronounced in weak non-oxidizing acids and at high velocities of flow past the metal.

2. The anode and cathode areas may be widely separated or closely adjacent, and any inert area (including rust) in electrical contact with the corroding anode may act as cathode. Contact with additional cathode area increases the corrosion of iron under natural waters by increasing the area to which oxygen can diffuse. (If a copper plate of the same size is attached under water to the iron plate being corroded, the corrosion rate of the iron plate is doubled.) Pitting effects are due to localized corrosion where the unattacked areas have been partly protected (usually by films) and have therefore acted as cathode toward the corroding pits.

3. The theories of direct oxidation or of colloidal catalytic activity can cover only a part of the phenomena observed in the submerged corrosion of steel. Each is contradicted by certain experimental facts, of which two of the more important are the action of copper in contact with steel under natural waters and the similarity in the actions of oxygen in natural waters and in acids.

## Ferrous Alloys Resistant to Corrosion

**By B. D. Saklatwalla**

Vanadium Company of America

Although it had long been recognized that certain percentages of chromium incorporated in steels rendered them non-corrosive, it was left to Harry Brearley of Sheffield, England, to prove that the non-corrosive properties were dependent more or less on the hardening imparted by heat-treatment, and this discovery suggested to him the use of this material for cutlery. The first knives manufactured and hardened were found to be not only rust resisting but also proof against discolorization by contact with vinegar and fruit juices. This suggested to a cutler, Mr. Stuart, of Mosley's, who made these knives, the idea of calling them "stainless." This adjective has been carried along, but its true significance has not been realized. By "stainless" is understood the property of not discoloring within a specified number of minutes, when a drop of a certain strength vinegar or an acidulated solution of copper sulphate or a similar solution is placed on the steel. The popular mind, however, has extended "stainless" to mean complete resistance to acids or atmospheric conditions, a condition that unfortunately is not realized.

A small amount of carbon exerts great influence on the properties of a chromium steel. Carbon in the presence of about 12 to 14 per cent chromium has about three times the hardening effect of similar amount of carbon in a plain steel. The quenching and tempering temperatures must be higher than in the case of ordinary steel. The presence of chromium decreases the rate of carbide diffusion in a steel and it imparts the air-hardening properties of these steels and also their capability of retaining strength at high temperatures. By variation of the carbon content with different quenching and tempering temperatures, a very great variety of physical properties can be obtained with the same chromium content. This fact fortunately makes the high-chromium steels applicable to nearly all purposes for which steel can be used. The commercial grades with varying carbon and varying heat-treatment offer a range of from 60,000 to 200,000 lb. per sq.in. tensile strength. Similarly the ductility and hardness can be varied to suit almost any engineering purpose.

The most generally known non-corrosive high-chromium steel is this so-called "stainless" steel used for cutlery purposes. It contains usually between 12 and 14 per cent chromium and between 0.25 and 0.35 per cent carbon. This composition is particularly adapted

for cutlery purposes, and it is with this use in mind that the limits of chromium and carbon and chromium were chosen. This composition, however, has little bearing on non-corrosive steels for general engineering purposes. With the development of "rustless" metallurgy, it was found that by decreasing the carbon to less than 0.15 per cent, with the same chromium content, a metal is obtained that is much more resistant to corrosive influences, more ductile for general fabricating purposes, and also, especially in the low-carbon ranges, say under 0.10 per cent, non-corrosive not only in the hardened but also in the annealed condition. Such steels are put on the market under the name of "stainless" or "rustless" iron. For resistance to oxidation at atmospheric and at higher temperatures, an increased chromium content seems to be beneficial. Steels with chromium content of 20 per cent or higher show remarkable properties of non-scaling at high temperatures and of resisting fresh and salt water corrosion.

From the standpoint of the chemical engineer the plain high-chromium carbon steels with any percentages of chromium and carbon, hardened or annealed, are likely to prove a source of some disappointment. In spite of their ability to withstand oxidation and staining from food products, and in spite of the prevalent popular belief, they are not resistant to action of acids. Although in contact with fruit acids for a short period they do not discolor, yet submerged for long periods in fruit and other organic acids they lose considerable weight through solution, and in mineral acids, with the exception of nitric, they show very quick dissolution. In fact, such steels are more soluble in hydrochloric and sulphuric acids than plain carbon steels.

### Nickel Improves Acid Resistance

In order to impart acid resistance to these steels, in addition to their property of withstanding oxidation, several other elements have been added. Nickel steels with about 25 per cent nickel content have excellent resistance to mineral acids, but they are expensive and are not amenable to general fabrication. The addition of nickel to the high-chromium steels imparts acid resistance, but as this resistance does not obtain until the nickel content is high, from 5 to 20 per cent, such steels suffer from the same deficiencies as the plain high-nickel steels. The original Pasel steels made by Krupp, and Johnson's "Rezistal" made by the Crucible Steel Co. of America are types of such steels.

Other elements have been added to impart acid resistance are molybdenum and tungsten. These elements, while not necessary in excessive percentages, generally not over 2 to 3 per cent, on account of their high price make such steels too expensive for wide use. The earlier steels of Borchers and Monnartz were of this class.

Copper can be added to high-chromium steels, imparting to them, together with their ability of withstanding oxidation, excellent acid-resisting properties without the drawbacks of any of the above-described elements. The amount of copper necessary for this purpose is small depending on the percentage of chromium, generally not exceeding 1.5 per cent and in many cases not even 0.5 per cent. Such copper-chromium steels, especially in the low carbon ranges (below 0.15 per cent carbon) present very remarkable all-around non-corrosive properties. The acid resistance is obtained not only without sacrificing any of the oxidation-resisting properties, but with an actual increase in oxidation resistance. Also the copper-chromium steels are not as dependent on the state of hardening for their non-rusting and non-corrosive properties as the plain high-chromium steels. On account of the low price of copper and the small amount necessary, these steels seem to have a very promising industrial future.

The future of commercial development and wide engineering application of high-chromium steels undoubtedly lies with the low-carbon alloys, either those containing chromium alone or together with another element such as copper. The great hindrance, however, to the rapid progress of commercial expansion has been the high cost of production of such steels. At the prevailing prices of these steels they can enjoy only a very restricted field. This high cost is due to the necessity of using a high-grade low-carbon ferrochromium for the introduction of the chromium content. Since the advent of "rustless" and "stainless" steels, the price of such ferrochromium has been decreased to 35 or 40 cents per pound of contained chromium, but when we consider that about 300 to 400 lb. of chromium is added for each ton of steel, the cost per ton runs up into figures that would make the steel thus produced incapable of ever competing with ordinary steel products, such as galvanized sheet or tin plate. However, within the last few years considerable metallurgical research work has been done, with the result that it is now commercially possible to produce on a large scale high-chromium steels without the use of the expensive ferrochromium. Chromium can be introduced into a bath of refined steel directly from chrome ore, reducing the chromium from the ore by means of silicon introduced into the melt. As chrome ore and ferrosilicon are both comparatively cheap and easily obtainable commodities, this direct process puts an entirely different commercial phase on the "rustless" industry. Chrome ore of a grade running about 50 per cent $Cr_2O_3$ is worth approximately $20 per gross ton, so that the unit of chrome content can be obtained in steel at only a small fraction of the 35 to 40 cents which is the case when ferrochromium is used. Consequently such a process will enable the production of high-chromium steels at comparatively very low costs, insuring the wide and extended use which they justly deserve.

## Why Enameled Iron Ware Warps

Enameled iron ware is much more likely to warp if the iron and enamel have different rates of thermal expansion than if they expand and contract at the same rate, the Bureau of Standards finds. Tests made at the bureau have also shown that warping is less likely to occur if the grease is burned off than if it is taken off with chemicals, and that warping is apt to result from sudden, irregular cooling or from failure to support the ware properly in firing. Thin metal is found to warp more easily than thick, but is more easily straightened.

The enamel used on such ware has for its chief ingredient a form of glass that is finely ground and mixed with other materials to form a paste which is applied to the surface of the metal, dried, and fired. The firing causes the glass to melt and adhere to the metal, while the other ingredients are dissolved in it. Warping sometimes occurs when the ware is cooled to room temperature after firing.

The tests were made on commercial enameling steel and sheet iron furnished by a number of manufacturers.

# Crystallization of Heavy Liquors

### Description of a Continuous Process Used in Handling Calcium Nitrate in Norway

**By N. Titlestad, Dr. Ing.**
Chemical Engineer, Ammonia Corporation, New York City

IN MANY manufacturing processes it is difficult to separate the product from the mother liquor, because of the high solubility of tne product. Frequently in such cases it is satisfactory to solidify the heavy concentrated liquor without separating from the crystals, as, for example, in the manufacture of synthetic nitrate of lime. The solidification may be carried out in different ways. It is probable that the method used by the Norwegian Nitrate Factories and described herewith could be utilized in other industries and might therefore be of interest.

The weak solution of nitrate of lime, obtained by neutralizing nitric acid with limestone and milk of lime, is concentrated in vacuum evaporators and a liquor of specific gravity 1.88 containing about 76 per cent calcium nitrate is obtained. At first this liquor was dumped into large open pans. There it remained for 2 or 3 days, while cooling and solidification took place. When the product had hardened sufficiently, which especially in summertime required much time, it was broken up with sledges and bars and pulverized. This method required not only much labor but also large floor space, and as a large increase in production was forecast, other more suitable methods were developed.

Experiments were made with an internally cooled rotary cylinder equipped with knives to remove the product. The first results did not look encouraging. The product left the cylinder in a state of a very viscous fluid, no matter at what temperature the liquid was fed to the cylinder or what temperature or quantity of cool water was used, or finally at what speed the drum was run. However, it was soon discovered that if the liquor was cooled down to the temperature at which crystallizing would take place and at the same time was seeded with crystals of nitrate of lime, the liquor then could be easily solidified.

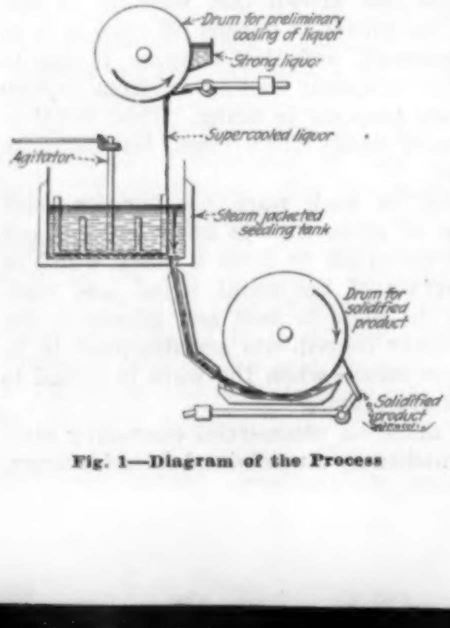



**Fig. 1—Diagram of the Process**

> ***CRYSTALLIZATION***
>
> **There are many products on the market that are crystallized in bulk without separating the mother liquor. These are frequently solidified in pans and the cake thus formed is broken up with bars. Often just such difficulties as those described in this article have militated against the installation of continuous processes. There is food for reflection in the article.**
>
> ***A UNIT PROCESS OF CHEMICAL ENGINEERING***

Some means of obtaining the seed crystals consequently had to be discovered. Every method of cooling the liquor in ordinary way, with cooling coils, cooled vessels with agitators, etc., failed, because the product hardened in successive layers and in that way choked up the system. The method finally adopted made use of another drum on which the liquor was supercooled. It was then discharged from the doctor blade to a steam-jacketed tank, equipped with agitator. The supercooling will now cause the crystallizing of a part of the nitrate corresponding to the rate of cooling. With a seeded mass in the tank, it is possible to maintain for months at a time a constant mixture that is suitable for solidification on drums. It is only necessary to regulate the supercooling on the first drum. The stirring tank, the feed pipes and the trough beneath the solidifying drum are heated by hot water to a temperature slightly above the crystallizing point, which is about 48 to 50 deg. C.

Fig. 1 is a diagram of the process. The hot liquid from the evaporators at a temperature of 100 deg. C. is supplied to a trough on one side of the cooling drum. The drum itself is about 3 ft. 6 in. in diameter by 4 ft. long, and makes about 2 to 3 r.p.m. The still liquid mass is removed from the drum by a suitable mounted knife or doctor blade and falls into the stirring tank. From here it flows at a carefully controlled rate into the trough underneath the solidifying drum. This drum is about 5 ft. in diameter by 7 ft. long and makes about $\frac{1}{2}$ r.p.m. The hardened product is scraped off by a number of knives, so set as to overlap one another, and each is pressed tight to the drum by heavy counterweights. The product is transported on a belt conveyor to the pulverizing mills. The capacity of one unit varies from 24 to 30 tons in 24 hours.

On the cooling drum only one knife could be used, for two or more knives would foul one another. This drum therefore had a limited capacity, as satisfactory knives could not be made over a certain length. On the other hand, the diameter of the drum could not be increased, because of the large resistance on the knives. This resistance is considerably increased if the drum is cooled too much and damage to the knives is almost inevitable. It is essential for the proper operation of the plant that the temperature of the cooling water both in the cooling drum and in the solidifying cylinder be kept above a certain critical point.

The experiments were made in relatively small scale and with apparatus that did not permit the operation of the unit continuously for a long time. From the experimental stage the process was at once developed on a large scale, about 200 tons a day, and the start was therefore looked upon with much scepticism on the part of the construction department. However, except for a few troubles at the start, the plant worked satisfactorily and in accordance with expectations.

## Refractories for High Temperatures

The Bureau of Standards recently tested a sample of fused zirconium oxide which a certain company is now developing on a commercial scale. Small crucibles of this fused zirconia have been made in the laboratory without an added oxide bonding material and with additions of 20 per cent thoria or 15 per cent alumina. Several of the crucibles withstood very sudden and uneven heating in the oxy-acetylene flame.

# Equipment News
*From Maker and User*

## Design and Operation of a Colloid Mill

**Description of a Device That Is Finding a Wide and Useful Place in Industry**

By William A. McLean
Chemist, Premier Mill Corp., Geneva, N. Y.

Modern industrial development is vitally concerned in processes and products of a colloid nature and to which the colloid mill is applicable. Power consumption, capacity and quality of product are factors of greater importance than the cost of installation, and for many years industrial engineers and chemists have hoped for a perfected device that would meet all the necessary conditions for successful application. This article deals with a mill that seems to meet industrial requirements, and the discussion is based upon a year of constant use of this mill on a wide variety of problems submitted by several industries.

The mill itself is the invention of Frederick J. E. China, chemist and plant manager for Burt, Boulton & Haywood, Ltd., of London, tar distiller and chemical manufacturer. The invention resulted from research and development in the processes and products of that company, where it was employed for about a year before publicity was given to it; the development of a colloid mill was of primary importance, and until its use and efficiency had been tested and proved in its own plants, exploitation for general industrial distribution was withheld.

The mill is particularly adapted to the economical disintegration of solid, plastic or liquid masses into colloidal particles whose dimensions are one micron or less in diameter. In the words of the inventor, it has developed a new art and technology—"mechanical chemistry."

It is in no sense a "beater" type, but on the contrary is a hydraulic disintegrator in which several forces are developed as well as an electric effect, and in the combined resolution substances are reduced to a colloidal state.

The basic principle involved in the internal disruptive forces created results in the minutest dispersion or disintegration of the materials, whether liquids, semi-solids or solids suspended in a liquid medium. Many solids are reduced to such a fine state of subdivision that they pass freely through filter paper.

The dispersion occurs within the liquid medium or film, so that the disruptive action is accomplished without attrition or actual contact of the surfaces of the rotor and stator. Such a method permits the disruption or grinding into the minutest particles, not only of solid substances but also of insoluble waxes and greasy materials to a degree unknown and in most instances heretofore impossible.

Reference to a section of the mill (Fig. 1) shows that it consists of an outer casing which surrounds the rotor, *R*. This rotor consists of a perfectly smooth face upon the frustum of a cone, which, for some conditions and processes requiring a preparatory action, may be truly conical, the apex extending into the sub-chamber, *SC*. The superficial area of the rotor is ground to extremely fine limits as regards accuracy and is affixed to the spindle, *SP*, which in turn is mounted in special ball bearings. This frustum (or cone) works in accurate and close relation to a similarly ground surface of the stator, *CS*, which is an integral part of the casing. The arrangement and adjustable relation of the rotor *R* and the stator *CS* are suggestive of the clutch action in a motor car, except, while in operation, the aperture or clearance is fixed and the surfaces are never in actual contact. The clearance is always fine and varies from 0.002 in. upward according to the materials and the desired degree of dispersion. The rotor in operation acts as a centrifugal pump and draws the materials continuously and with great force into and through the sub-chamber *SC*. Action upon the surfaces of the rotor and stator are negligible.

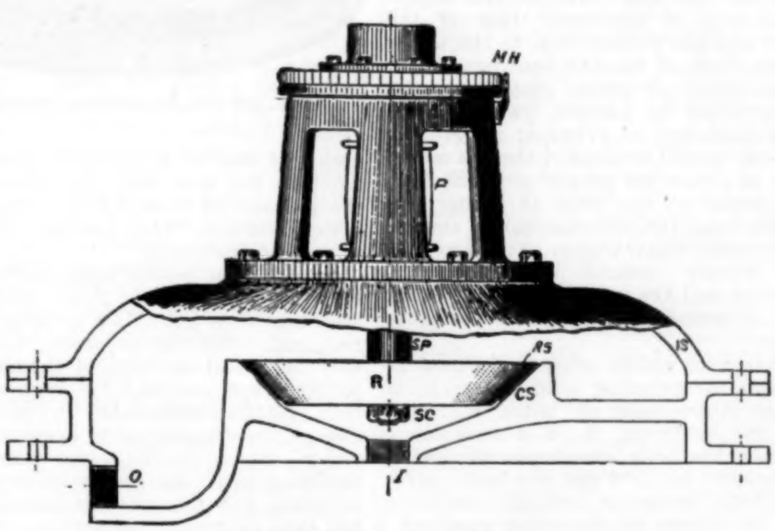



Fig. 1—Section Through Mill

There are therefore two surfaces in exceedingly close proximity, while the speed of the rotor *R* may vary from 1,000 to as high as 20,000 or more revolutions per minute, according to the size of the mill and the required peripheral foot-second speed essential in producing the proper disruption.

The rotor *R* is driven by the pulley *P*, mounted on the spindle *SP*, while the bearings controlling this spindle are mounted in a micrometer head, *MH*, thus permitting any degree of clearance between the opposing surfaces of the rotor *R* and the stator *CS*.

The mills are furnished in two types, with or without jacket, so that heating or cooling may be effected during operation. When heated or cooled, care should be taken to calibrate the clearance at the required temperature. The Golden Rule of operation is, Never use a finer clearance or a higher speed than is required to do the work at hand. A strict observance of this rule will insure a uniform product.

Although the general form of the mill is standardized, yet for various specific uses other forms have been developed. For soda fountains, hotels, hospitals and domestic use, a horizontal type; for excessive speed requirements, with two rotors running in opposite directions, the present stator becoming a rotor; the mushroom type with dome removed and base drive, for homogenizing and spray drying of milk, malt

powders, fruits and similar products. Other changes involve a complete conical rotor with milled or grooved surfaces upon rotor or stator, and similar millings upon the surfaces of the standard type.

Liquids are easily fed to the mill by gravity or slight pressure, but solids for suspensoids or wet grindings must first have a primary grinding from 75 to 150 mesh. It is evident that the finer such preparation the more easily minute dispersion is obtained.

The materials are fed into the mill through the inlet *I* at a suitable rate so that the sub-chamber *SC* is filled at all times and thus prevents the influx of air, which, depending upon viscosity and materials, tends to "whip" or "cream" the product. Unless this supply is sufficient to furnish the mill to the capacity set, the action of the mill is not normal and proper results cannot be assured. The supply may be furnished by slight gravitation (the usual method), or with a feed pump for viscous materials. The pump is often used for transportation and supply. Pressure, while not detrimental, is a useless high additional cost and nonessential for operation or results.

Many substances that will not flow rapidly require slight pressure to be applied for the feed. This may vary up to 8 lb. per square inch as a maximum; but the limits of pressure are determined for each size by the superficial area of the lower face of the rotor and are proportional to the upper thrust limit of the ball bearings.

Materials of great viscosity resist being lifted by suction, owing to the high coefficient of friction; no greater velocity should be applied than is necessary to obtain the proper constant flow. The action of the rotor in lifting materials from the sub-chamber is similar to the centrifugal pump. Viscosity and the supply control are important features and are governed by conditions such as temperature and chemical properties.

This mill, unlike other mills used at present for grinding solid materials, is not an intermittent or "batch" machine. On the contrary, it is a continuous process, the 15-in. rotor type producing from 1,000 to 1,500 gal. per hour, varying with viscosity, weight, hardness and the degree of dispersion required.

The period of treatment is determined by the length of the parabolic path of any particle through the clearance from inlet to exit. This path terminates without one complete revolution of the rotor, and the time of travel of a particular particle through the clearance is approximately 0.01 second, varying, however, with conditions of speed and clearance as well as with materials. Disruption and dispersion are so complete that all masses entering as a solid or fluid are expelled as a colloidal mist. Likewise, all materials passing through the mill must always receive the same complete treatment, which is not the case in the beater mill type.

For use as an emulsifier the action of the mill is exemplary and successful, this class of work being the simplest to perform. The 15-in. rotor with a water capacity of 1,500 gal. will pass 6 tons per hour; while with solids, such as iron oxide, felspar, phosphate rock and similar substances, from 1 to 2.5 tons per hour may be milled with the passage of from 3.5 to 5 tons of a water medium. One passage through the mill is sufficient.


Fig. 2—Mill With Direct Motor Drive

Unlike some beater mills, there is no rise of temperature from operation, and therefore a cooling system is not required. The temperature, however, may be raised or lowered through the jacket, when required for running certain plastic materials, in order to change the viscosity or to prevent hardening. Steam is the usual method of applying heat, but in cases requiring accurate and uniform temperature oil has been deemed preferable.

The disruptive action of the mill has been described as the resolution of several forces in combination: (*a*) The disintegration is carried out by hydraulic forces, the film of liquid being actually sheared under conditions that do not permit of the liquid acting as a liquid but as a solid, so that all particles in the line of shear must themselves become disintegrated during the shearing. (*b*) Internal disruption within the liquid medium by attrition due to the contact between the particles themselves. (*c*) The effectual lamination of the liquid under great pressure, due to the fact that one surface is retarded by contact with the stator and the other revolved rapidly in contact with the rotor. This produces an effect similar to that observed when a flat-bottomed boat is passed rapidly over the surface, the action decreasing with the depth; or it might be applied to the action of a pack of cards on material between the cards themselves spread for a cut on the table under heavy pressure of the hand. (*d*) Disruption of the liquid medium, due to the differential speed of the particles while traveling around and upward through the clearance on a parabolic spiral with increased diameter and consequent increased peripheral speed at each infinitesimal point of progression. (*e*) The electrical forces generated, particularly in emulsions, the resolution of which in relation to the product seems to upset the prevailing laws regarding stabilizers, in some cases requiring a different substance and invariably a minimum quantity. Many emulsions that formerly required from 8 to 15 per cent of the protective colloids are made stable with from 0.25 to 3.5 per cent. The control of these electric forces applied to clearance and speed will eventually determine many of the laws peculiar to this mill only.

The grinding of solids, as well as emulsifying, is governed by two factors—viz., the clearance or space between the rotor and stator, and the speed. For a specific problem the relation between these two elements is quite uniform, but directly either is varied, the constant must be maintained by a proper change in the other. For example, the smaller the clearance or the higher the speed the greater is the dispersion, and vice versa; hence within limits the decrease of clearance permits a reduction of speed and increase of clearance requires an increase of speed. Therefore, as both speed and clearance are capable of innumerable combinations, the functions and possible applications of the mill are almost unlimited, which is not the case with the heater type, which permits of but one variant, speed.

Photomicrographs are not yet available in this country to furnish accurate data as to the comparative size of materials that have been ground or emulsified in this colloid mill; but these will later be shown in the production of solids, such as glass, corundum, iron oxide, feldspar, sulphur, residual carbon, china clay, zinc oxide, graphite and similar substances compared under 1,000 and 2,000 diameters—all of which show the Brownian movement when viewed with the ultra-microscope equipped with a dark, ground illuminator. With few exceptions, the size of the particles is less than one micron and varies downward to invisibility. The degree of fineness produced with the Premier colloid mill is not obtainable by any other grinding machine; and many substances heretofore impossible of reduction to the colloidal state are thus successfully dispersed.

### Chemical Reactions

Strange and rather unique phenomena have appeared in several cases when stability in a given product under other methods has shown Brownian movement, but with this colloid mill they have permanency and stability without such movement, probably due to the electric effect mentioned in combination with the other forces, the small amount of stabilizer required and the

completeness and adherence of the film coating applied.

The action of the mill being instantaneous, chemical reaction increasing as dispersion and interfacial area increase, such reactions are equally instantaneous. Purification of organic chemicals is now accomplished by selective emulsification and is a new branch of chemical technology. The impurities in the chemical are emulsified with proper substances and pass off, leaving the purified chemical. This is now accomplished with crude naphthalene. Reductions and chemical separations, by breaking down emulsions, are now practiced. The continuous production of carbolic and cresylic acids from tar oils is accomplished by passing the tar oils through the mill; the tar oil carbolates and cresylates separate upon the breaking down of the emulsion at the rate of 1,500 gal. per hour with one mill.

While in some cases the addition of certain substances in small amounts to aid in dispersion has been a general and well-known principle, yet with this colloid mill such substances are rarely of advantage, the protective colloid in small and minimum amounts being sufficient. It has been explained that the function of the dispersator is to put an electric charge on the particles. The electric effect of the mill, however, seems to eliminate the necessity of such a substance. Distribution and the law governing the control have, as yet, not been definitely enough worked out to warrant publication. In most cases where a dispersator has been beneficial, acids prove most efficient.

### Power Consumption

The drive is obtained with belt, direct-coupled, vertical motor or steam turbine. The table of tests for a 15-in. mill with belt drive carried out in England within the past 2 months is as follows:

Running empty, 3,000 r.p.m., the mill required 2.5 kw. The mill under water load, passing 1,500 gal. per hour, shows a power consumption of 19.25 kw. On this basis, under load per hour of from 1 to 2.5 tons solid matter, such as iron oxide, with water passage of from 3.5 to 5 tons, the power consumption is 19.25 kw. While viscosity of the product will vary these figures somewhat, yet for water grinding, as shown, the cost of solid matter per ton, at 2 cents per kilowatt is from 16 to 40 cents, or 3.8 to 9.6 watt-hours per pound of solid, which includes the milling of from 3.5 to 5 tons of water.

In the production of emulsions, except in case of great viscosity, the power required is considerably less, and where pressure feed is required, the mill load or suction lift is greatly reduced and consequently capacity is increased and power consumption reduced, giving a lower cost. The cost of liquids based on 19.25 kw. per hour is 6.7 cents per ton, or 1.6 watt-hours per pound. This low power cost is due to the high capacity in production.

In case higher speeds are required, the power consumption increases, but the percentage of increase can be determined only by the nature of the materials and the degree of dispersion required, as determined by the change in clearance. The foregoing figures, however, based upon water load and mill production of solids treated, should furnish a reasonable comparison between this mill and those of the beater type.

The mills are of heavy construction, the 15-in. rotor size weighing 1,325 lb. The construction is simple, there being but a single unit in action, the rotor. Two self-aligning ball bearings constitute the only wearing parts. As there is no contact between rotor and stator, there is no appreciable wear on these members. If, however, small pittings or erosion appear, the rotor and stator may be "ground in," similar to the operation employed with the valve in an automobile engine, and under its own power (but at a greatly reduced speed —100 to 150 r.p.m.), the same as when originally ground at the factory. Mills that have been in continuous operation for more than a year have shown no appreciable effect, and a regrinding, which requires not over 30 minutes, once a year should be sufficient.

### Industrial Uses

The advantages claimed are economy, low installation cost, simplicity, durability, low power consumption and labor, no pressure requirement, high production capacity, quality and uniformity of product.

The applications of this colloid mill in industrial work are numerous. New products and processes continue to appear from time to time, thus adding to the present enormous field. Economy of operation and quality of products promise to make the mill a necessity in a variety of industries. The following uses will doubtless suffice to show that the mill is revolutionary in its character: emulsions, suspensoids, minute disintegration of liquids, solids and semi-solids, homogenization in all of its aspects, intensive mixing, reductions, chemical purifications, separations, regenerations, washings, blendings, wet grinding, de-inking and grinding of paper in one operation.

## Pressure Governor

A new pressure governor, for use in maintaining pressure in air and water systems, operates in conjunction with magnetic starting panels controlling motor-driven pumps, air compressors and similar equipment.

In operation, the governor element is set for a maximum and minimum range of pressure. An auxiliary relay is energized to open the control circuit of the panel when maximum pressure is reached and to close it at the minimum pressure. The electrical connections are so arranged that the governor contacts make contact only, not carrying current or breaking contact, thus insuring longer life of contact tips.

The electrical mechanism is of strong construction. Contact tips are silver plated to give low resistance contact and to eliminate burning and sticking. The device is inclosed in a cast-iron box with a glass window through which the indicating dial is visible. The complete unit is designed for wall mounting. It is approximately 10 in. square and 4 in. deep. It is made by the General Electric Co.

## Manufacturers' Latest Publications

Warren Webster & Co., Camden, N. J.—A book called "Webster From the Air," containing many interesting aërial photographs of representative American cities and an account of Webster steam-heating systems.

The Foxboro Co., Inc., Foxboro, Mass.—Bulletin 154. A folder on the new improved Foxboro helical tube movement for recording instruments.

Acme Products Co., Inc., De Quincy, La. —A catalog on steam-distilled pine oil, discussing its source, production, use, constituents, analysis and specifications.

Automatic Primer Co., Chicago, Ill.—A folder on automatic primers for centrifugal pump service.

F. J. Ryan & Co., Philadelphia, Pa.—A new bulletin on automatic temperature control by the Ryan-Austin system, giving facts on the use of this system in gas- and oil-fired operations.

Graver Corporation, East Chicago, Ind.—Bulletin 505 I. A booklet describing the new Graver intermittent water softener.

Ottumwa Box Car Loader Co., Ottumwa, Iowa.—A folder on the Ottumwa self-propelled box car loader, which operates by motor or gas engine.

Lammert & Mann Co., 215 N. Wood St., Chicago, Ill.—Catalog describing the line of vacuum and pressure pumps manufactured by this company.

Clement K. Quinn & Co., Duluth, Minn. —A booklet giving the 1924 analyses of Lake Superior iron ores. Also a folder on the use and effects of manganiferous iron ores.

Wilson-Maeulen Co., 383 Concord Ave., New York City.—A folder on the Rockwell direct-reading hardness tester for testing metals.

The Ohio Steel Foundry Co., Springfield, Ohio—Bulletin C. An illustrated bulletin describing the properties and uses of "Fahrite" high-temperature-resisting alloy castings.

Detroit Electric Furnace Co., Detroit, Mich.—A booklet describing the economies effected by using electric furnaces for melting brass.

Doolittle Stephens, Ltd., Hagersville, Ont., Canada—A folder describing the Stephens bucket elevator belt protector.

Automatic & Electric Furnaces, Ltd., 173 Farrington Road, London, E. C. 1, England—A catalog describing the use of the Wild-Barfield system of electromagnetic furnaces for use in the automatic hardening of steel.

Metals Coating Co. of America, 495 North 3d St., Philadelphia, Pa.—A catalog describing methods of preventing corrosion by coating steel and iron with corrosion-resisting metals by means of the Schoop process.

Mesta Machine Co., West Homestead, Pa.—Bulletin U-1. A bulletin describing the results of recent tests on the Mesta type of "Una-Flow" steam engines.

The Connersville Blower Co., Connersville, Ind.—Bulletin 21-A. A new bulletin giving full information on the "Victor" type of positive pressure blowers.

C. L. Best Tractor Co., San Leandro, Calif.—An interesting illustrated booklet entitled "The Open Road," which describes the use of Best tractors in removing snow from highways.

General Electric Co., Schenectady, N. Y. —Bulletin 48721. An illustrated booklet describing the use of direct heat electric furnaces in the General Electric factories, illustrating the use of this type of heating equipment for the annealing of castings and wire, for heat-treating, calorizing, sherardizing and other processes.

Link-Belt Co., Philadelphia, Pa.—Folder 662. folder on the new Link-Belt vibrating screen, which operates on a new mechanical principle consisting of a high-speed rotating unbalanced pulley, which imparts continuous vibration to the screen surface.

The Cambridge & Paul Instrument Co., Inc., New York City.—A booklet describing the use of Cambridge & Paul instruments at the British Empire Exhibition at Wembley.

The Esterline-Angus Co., Indianapolis, Ind.—Bulletin 324. A bulletin on the subject of the use of graphic meters in small power plants.

Hooker Electrochemical Co., Niagara Falls, N. Y.—Bulletin 1. A new bulletin on the subject of liquid chlorine.

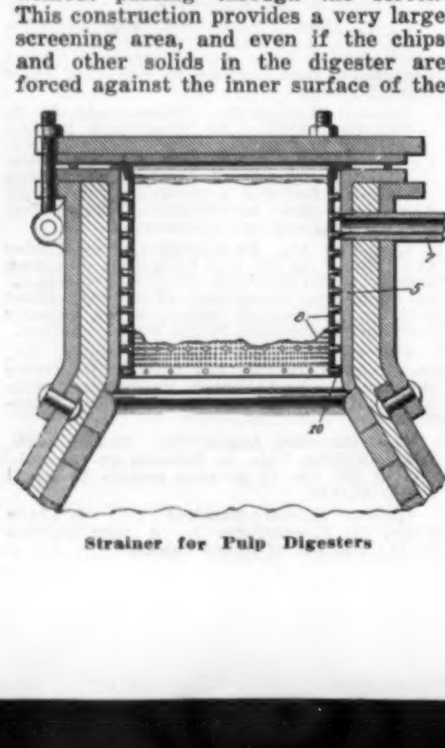
# Review of Recent Patents

## Suggestions on Pulp Manufacture

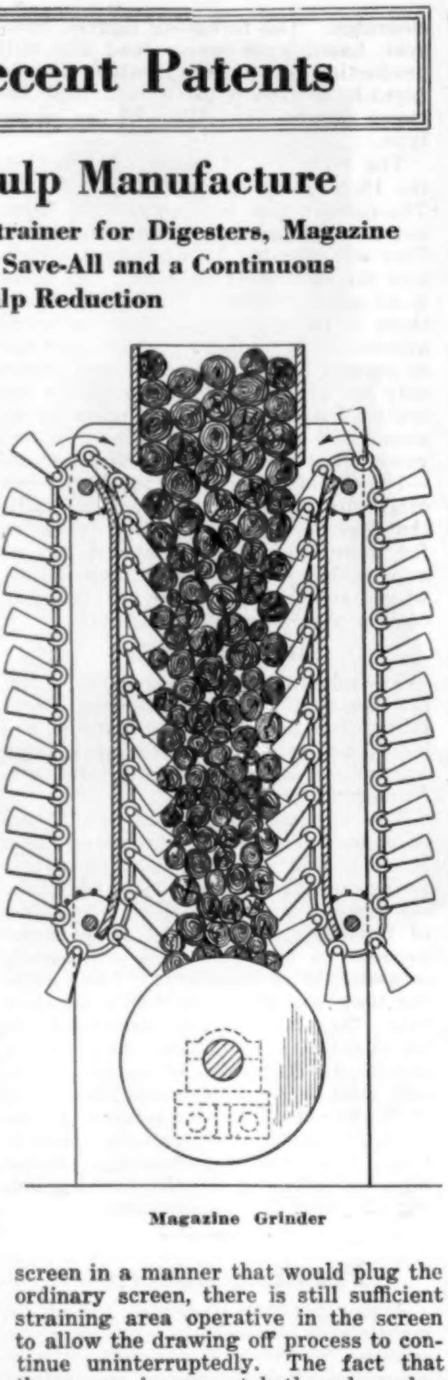
### Recent Developments Include Strainer for Digesters, Magazine Grinder, Simple Design for Save-All and a Continuous System for Pulp Reduction

CARLTON H. ALLEN, of Glens Falls, N. Y., has designed a strainer for pulp digesters, particularly sulphite digesters, that overcomes some of the difficulties encountered in relieving pressure. (1,487,004; March 18, 1924; one-half assigned to Great Northern Paper Co.) During the cooking of a charge of pulp in a digester, it is necessary occasionally to open the discharge pipe that leads from the upper part of the digester in order to draw off some of the fluids and thereby relieve the excessive pressure created in the digester by the liberation of sulphur dioxide. A strainer is usually located in the neck of the digester to prevent the chips and other solid material from being forced into the discharge pipe by the rush of fluids out of the digester. Such strainers are the cause of a great deal of trouble due to their liability to become clogged or plugged with chips, and it is usually the custom, therefore, to connect live steam to the relief side of the strainer so that when the strainer has become plugged steam can be forced through it to clear it. The fact that it is necessary to resort to such an expedient obviously interferes with the operation of drawing off fluids from the digester, and it is impossible to use such a strainer with an automatic mechanism for relieving pressure in the digester.

Mr. Allen's strainer, shown in the accompanying illustration, consists essentially of a cylindrical perforated lead screen 8 placed in the interior of a bronze collar 5 forming the neck of the digester. The screen is held away from the collar by a series of studs, and a brass ring 10 at the lower end of the screen prevents any material from reaching the discharge pipe 7 without passing through the screen. This construction provides a very large screening area, and even if the chips and other solids in the digester are forced against the inner surface of the screen in a manner that would plug the ordinary screen, there is still sufficient straining area operative in the screen to allow the drawing off process to continue uninterruptedly. The fact that the screen is open at both ends makes it unnecessary to remove this device after it has once been placed in position, the filling or charging operation being performed by dumping the materials into the digester just as though the screen were not present.



Strainer for Pulp Digesters



Magazine Grinder

### Magazine Grinder

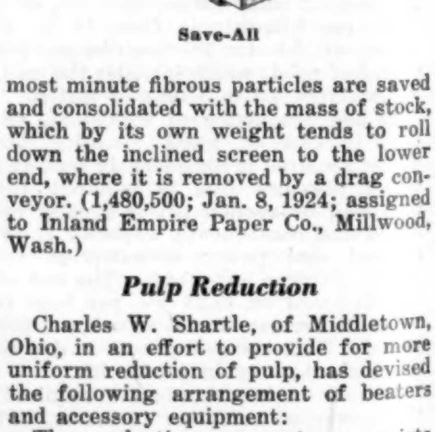
Paul Priem, of Heidenheim-on-the-Brenz, Germany, has assigned to the American Voith Contact Co., of New York, Patent 1,487,601, issued March 18, 1924, covering a continuous grinder for the production of ground wood pulp.

Wedge blocks pivoted on endless chains force the charge of wood against the grindstone. In operation the wedge blocks gradually vary their inclination from a downwardly inclined position to a position more nearly horizontal. Thus, if the wedge blocks at the outset of their working travel assume an angle of 60 degrees from the horizontal, their speed of advance may be so much greater with respect to the speed of consumption of the charge by the stone that as the wedge blocks approach the stone they assume an angle of only from 30 to 45 degrees. It is obvious that this change in angular position of the wedge blocks exerts a lateral compression of the charge as it approaches the stone, so that a simultaneous forward feed and lateral compression of the charge take place. The effective result is a substantially uniform thrust of the charge throughout its entire working area against the stone. The extent of angular variation of the wedge blocks during their working travel may of course be varied by varying the speed of drive of the carrying chains, and may be varied in accordance with the nature of the wood which forms the charge. It is interesting to note that many installations of the equipment covered by this patent have already been made in this country.

### A Simple Save-All

George W. Brown, of Millwood, Wash., has developed a simple device for recovering pulp fibers from white water. It consists of an inclined screen, the lower edge of which is so supported that the angle of the screen can be adjusted according to the nature of the particular pulp under treatment. The upper part of the screen is 100 mesh, while the remainder is 60 to 70 mesh, and in order to keep the fine screen open a shower pipe is placed in back of this portion of the screen. White water flows onto the screen through discharge gates in the upper flume.

The fine upper mesh portion serves to start the gathering of the stock on the top of the screen, and once the stock has gathered, the mass tends to act as a filter for the white water following behind so that all except the most minute fibrous particles are saved and consolidated with the mass of stock, which by its own weight tends to roll down the inclined screen to the lower end, where it is removed by a drag conveyor. (1,480,500; Jan. 8, 1924; assigned to Inland Empire Paper Co., Millwood, Wash.)



Save-All

### Pulp Reduction

Charles W. Shartle, of Middletown, Ohio, in an effort to provide for more uniform reduction of pulp, has devised the following arrangement of beaters and accessory equipment:

The reduction apparatus consists essentially of a raw stock breaker and a battery of five finishing beaters. The breaker is provided with a weir and

overflow box from which the stock passes to a circulating pipe. This has branch feed pipes supplying each finishing beater, the stock passing first through a settling trough to remove heavy fibers and impurities before entering the beater. The circulating pipe ends at the bottom of a stuff chest, the overflow being returned to the breaker, thus providing a continuous supply of stock for the beaters. In the beaters the stock is ground to the required state and then discharged through dump valves or perforated back-falls to a stuff chest for finished pulp.

## Batches for Sheet Glass

### Arsenic and Calcium Sulphate Substituted for Sodium Sulphate in Fining Melt for Plate and Window Glass

Frederick Gelstharp, of Tarentum, Pa., has been granted two patents (1,488,914 and 1,488,915, assigned to Pittsburgh Plate Glass Co., April 1, 1924) on modifications of sheet glass batches in which the usual fining agent sodium sulphate, is replaced entirely or partly by $As_2O_3$ or gypsum. The use of arsenic has the added advantage of producing a glass freer from seeds.

The new formula using an increased amount of arsenic may be contrasted with the old batch as follows.

| | New | Old |
|---|---|---|
| Sand | 1,000 | 1,000 |
| Soda ash | 298 | 298 |
| Salt cake | 5 | 60 |
| Sodium chloride | 25 | 25 |
| Limestone | 309 | 309 |
| Arsenic | 15 | 5 |
| Sodium nitrate | 30 | ... |
| Charcoal | ... | 3 |

With the old batch the boiling or ebullition for fining the glass is produced by the decomposition of the salt cake, which is made effective by the action of the charcoal or coal, and the reducing flame of the furnace. They act to change a part of the salt cake into a sulphide, arsenate and sulpharsenate also being formed, these compounds together then reacting with some of the undecomposed salt cake, producing a boiling effect in the molten glass when its temperature has reached the fining stage. This boiling action in the concluding portion of the operation serves to clear the glass of a large portion of the bubbles held in the glass, such action being known in the art as "fining the glass."

With this process, the finished glass still contained an undue amount of very fine bubbles, which rendered the glass unfit for certain purposes such as silvering. As this glass always contains 0.7 to 1 per cent of sodium sulphate, it would seem that the seeds are caused by the decomposition of salt cake after the completion of the main fining operation.

The primary boiling or fining action with the new process is secured from the sodium nitrate with the arsenic, and by arsenic is meant the white arsenic or arsenious oxide of commerce. Such sodium nitrate supplies oxygen to the arsenic to change it from the lower oxide $As_2O_3$ to the higher oxide (arsenic oxide, $As_2O_5$), in which form it unites with some of the soda and calcium in the batch, forming sodium arsenate and calcium arsenate, and remains for a longer time in the metal. That is, the higher oxide, combined with the soda and calcium, is in a more stable form which resists decomposition until the time is reached when the fining or boiling operation is effective finally to clear the glass. Without the sodium nitrate or some other oxidizing agent, the arsenic has a tendency to vaporize and be lost before the final fining operation.

The boiling or fining action is therefore accomplished independently of the salt cake, and the latter almost disappears from the finished glass, which gives an analysis showing sulphur corresponding to only 0.07 per cent of sulphate, as opposed to sulphur corresponding to 0.7 per cent or more of salt cake found in all glass produced by the salt cake fining operation. In other words, only about one-tenth as much sulphate is left in the glass as is the case in ordinary sheet glass formed by the recognized and universally used salt cake method. The new process produces a much greater amount of silvering glass than the salt cake method, and of a better color and clearer, due to the absence of the charcoal and sulphur, which is of special importance when the glass is to be used for optical glass, one of the large uses of the glass being for spectacles. In the making of the spectacle blanks the ordinary practice is to cast the glass in sheets like plate glass, which are then cut up into blanks, usually after the plates are ground and polished. The operation of this process is also cheaper, since the corrosive effect of the salt cake on the pots is largely done away with and there is a saving due to the lower fusing point of the batch.

The small amount of salt cake retained functions in the following manner: In order to get a glass sufficiently strong or resistant to be used for sheet glass, such as plate, window or optical glass, it is desirable that a relatively high proportion of lime ($CaO$) as compared to soda ($Na_2O$) should be used in the batch or melt. In such a glass—that is, with the proportion of lime to soda 1 to 2 or greater—a scum is formed on the surface of the metal which is very difficult to get rid of and which comprises a high silicate of calcium and sodium. Mr. Gelstharp has found that a small amount of salt cake acts in some way to cause the complete disappearance of this scum.

## American Patents Issued April 15, 1924

The following numbers have been selected from the latest available issue of the *Official Gazette* of the United States Patent Office because they appear to have pertinent interest for *Chem. & Met.* readers. They will be studied later by *Chem. & Met.'s* staff, and those which, in our judgment, are most worthy will be published in abstract. It is recognized that we cannot always anticipate our readers' interests, and accordingly this advance list is published for the benefit of those who may not care to await our judgment and synopsis.

1,490,191—Welding Apparatus. Chester T. Alcutt, Pittsburgh, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,490,207—Electric Furnace. Ora A. Colby, Irwin, Pa., assignor to Westinghouse Electric & Manufacturing Co.

1,490,208 — Method of Desiccation. Walter L. Fleisher, New York, N. Y., assignor to American Drying Processes, Inc., New York.

1,490,213—Process for Treating Oil Shale. James B. Jenson, Salt Lake City, Utah.

1,490,309 — Tanning Vegetable Glue. Glover M. Birk, Indianapolis, Ind.

1,490,325 — Purifying Apparatus for Liquid Hydrocarbon. Walter Johnson, North Loup, Neb.

1,490,330—Glue and Process of Making Same. Paul Kreismann, Chicago, Ill.

1,490,354 — Process for Carbonizing Coal. George W. Wallace, East St. Louis, Ill., and Arthur W. Warner, Media, Pa., assignors to Wallace Coke, Oil & By-Products Co., East St. Louis, Ill.

1,490,358 — Treatment of Rubber. Ruben Zertuche, Washington, D. C., assignor to Secretary of War of the United States of America.

1,490,392—Mixer. Frank X. Lauterbur, Sidney, O.

1,490,396—Tunnel Kiln. Paul A. Meehan, New Castle, Pa., assignor to American Dressler Tunnel Kilns, Inc., New York.

1,490,433 — Tunnel Kiln. Harry M. Robertson, Rockville, Md., assignor to American Dressler Tunnel Kilns, Inc., New York.

1,490,469—Process of and Apparatus for Making Gas Black. Wilbur G. Laird, New York, N. Y., assignor to Henry L. Doherty, New York.

1,490,499 — Process for Working Up Copper Cellulose Sludge. Arthur Zart and Leonhard Monkemeyer, Oberbruch, Germany, assignors to Vereinigte Glanzstoff-Fabriken A.-G., Elberfeld, Germany.

1,490,520—Process of Drying Alcohol. John A. Steffens, Brooklyn, N. Y.

1,490,521—Apparatus for Flattening Glass. Laurence E. Stewart, Bradford, Pa.

1,490,523—Process of Manufacturing Paper. Logan G. Thompson, Cincinnati, O., assignor to Champion Coated Paper Co., Hamilton, O.

1,490,546—Apparatus for Producing Pure Nitrogen. Carl Theodor Thorssell and Harold Ludwig Reinhold Lunden, Gottenberg, Sweden, assignors to Aktiebolaget Kvafveindustri, Gottenberg, Sweden.

1,490,569—Process of Drying Control. Arthur E. Krick, Danville, Ind.

1,490,588—Process for Condensing the Acid Fumes Evolved During the Concentration of Sulphuric Acid. William Alexander Skeen Calder and William Harold Palmer, Birmingham, England, assignors to Chance & Hunt, Ltd., Birmingham, England.

1,490,590—Drying Machine. Gustav A. Carlson, Chicago, Ill., assignor to Boye Needle Co., Chicago, Ill.

1,490,627—Fixation of Nitrogen. Herbert B. Moses, Washington, D. C.

1,490,646 — Dyestuff. John Thomas, Carlisle, England, assignor to Scottish Dyes, Ltd., Carlisle, Cumberland, England.

1,490,728—Process for the Recovery of Ammonia and Other Valuable Chemicals From Waste Denitration Liquors. Emile Bindscnedler, Lansdowne, Pa., assignor to Tublize Artificial Silk Co. of America.

1,490,732—Electric Furnace. Thomas F. Callaghan, Cleveland, O., assignor to E. C. Uihlein, Milwaukee, Wis.

1,490,743—Vacuum Evaporation Apparatus. William Henry Johns, Kingsport, Tenn.

1,490,761 — Loop Drier. Hermann Bogaty and Frederick Kershaw, Philadelphia, Pa., assignors to Proctor & Schwartz, Inc., Philadelphia.

1,490,769—Continuous Process for the Manufacture of Barium Hydroxide. Camille Deguide, Enghein, France.

1,490,774—Process for the Manufacture of Artificial Fertilizers. Charles Harnist, Berlin, Germany.

1,490,794—Method of and Means for Separating Liquids of Different Specific Gravity. Harold Montague Alexander, Bexley Heath, England.

1,490,862—Process for Distilling and Cracking Oils. Vergil T. Smith, San Francisco, Calif.

Complete specifications of any United State patent may be obtained by remitting 10c. to the Commissioner of Patents, Washington, D. C.

Salt cake at times becomes very scarce and it therefore becomes desirable to provide a substitute which can be readily obtainable at all times and at a cost below that of the salt cake. It has been found that calcium sulphate constitutes such a substitute in securing a fining of the glass and such compound may be introduced in various forms such as ground gypsum or anhydrite or a calcined gypsum (plaster of paris) or precipitated sulphate of calcium.

### *Use of Gypsum in Lime Glass*

When gypsum is substituted for salt cake as a fining agent, the batches may compare as follows:

| | New | Old |
|---|---|---|
| Sand | 1,000 | 1,000 |
| Soda ash | 317 | 284 |
| Salt cake | ... | 60 |
| Gypsum | 69 | ... |
| Limestone | 268 | 309 |
| Salt | 25 | 25 |
| Coal | 3 | 3 |
| Arsenic | 5 | 5 |

The calcium reacts with some of the soda ash to form sodium sulphate, such action occuring at a stage in the melting operation preceding the fining. The action in fining is then similar to that when salt cake is used.

## New Publications

### *Chemical Reviews: A New A. C. S. Publication*

For several years the editors of the American Chemical Society's journals and some of the editors of the monograph series have felt that there was a need for a new publication to take care, on the one hand, of extended articles submitted for publication in the journals which, although of a valuable nature, were not essentially original research and, on the other hand, of monograph material which was not extensive enough to be issued in book form. After consultation with numerous members of the society, a plan was drawn up and presented to the executive committee of the society which received its unanimous approval. Briefly, it is as follows: A publication, to be called *Chemical Reviews*, consisting of a yearly volume of about 500 pages, will be issued in four numbers, in January, April, July and October. This publication will be devoted to articles of from about twenty to fifty pages embodying reviews or essays by specialists which might not consist essentially of results of their personal research.

The editor-in-chief is Prof. W. A. Noyes, editor of *Scientific Monographs*, and he is assisted by the editorial boards of *Scientific Monographs* and *Technologic Monographs*, ex-officio.

The price of the publication is $4 a year to members of the American Chemical Society and affiliated societies granting special privileges to members of the American Chemical Society and $5 to others.

Contributors to *Chemical Reviews* will receive twenty-five reprints free of charge and arrangements can be made with the publishers for the purchase of additional reprints. There will be no other remuneration.

*Chemical Reviews* will not be confined to articles on purely theoretical topics but will also accept articles of suitable nature on industrial topics. Contributions should be sent to Prof. Lafayette B. Mendel, Yale University, New Haven, Conn., who is acting editor in the absence of Dr. Noyes.

By arrangement with the authorities of Yale University, the first volume will contain the essays which were written for the dedication of the Sterling Chemical Laboratory.

## Important Articles in Current Literature

More than fifty industrial, technical or scientific periodicals and trade papers are reviewed regularly by the staff of *Chem. & Met.* The articles listed below have been selected from these publications because they represent the most conspicuous themes in contemporary literature, and consequently should be of considerable interest to our readers. A brief résumé of each article is included in the reference given. Since it is frequently impossible to prepare a satisfactory abstract of an article, this list will enable our readers to keep abreast of current literature and direct their reading to advantage.

"The Crude Oil of Sarawak." *James Kewley* of Maidan-i-Naftum. *A. E. Dunstan.* Occurrence and characteristic distillation data. *J. Inst. Petr. Tech.*, February, 1924, pp. 42-82.

"Protection of Oil Storage Tanks From Lightning." *W. R. Macdonald.* Discussion of experiments with various conductors. *J. Inst. Petr. Tech.*, February, 1924, pp. 92-9.

"Cutting Corners in Material Handling." *A. G. J. Rapp.* Horizontal conveyors, vertical hoists, tractors and cranes show enormous savings. *Blast Furnace & Steel Plant*, April, 1924, pp. 12-16.

"Experimental Coal Gas Plant at Leeds University." A description of the new coal-gas installation for experimental work on a small scale. *Gas Journal* (London), April 2, p. 27.

"Transmission of Heat in Boilers." *W. N. Booth.* A discussion of the physical factors affecting boiler efficiency. *Gas Journal* (London), April 2, p. 36.

"Low-Temperature Fuel Treatment in Gas Works." *N. E. Rambush.* An excellent description with operating results of the Scunthorpe installation. New gas-cooling and gas-condensing equipment is included. *Gas Journal* (London), March 26, pp. 768-772.

"Coke-Handling Plant at the Portsmouth Gas Works." *S. E. Whitehead.* Complete description with operating costs of all mechanical equipment. *Gas Journal* (London), March 26, pp. 780-7.

"Scott Moncrieff Smokeless Fuel Process." Operating results at Newhaven gas works using this low-temperature carbonization system. *Gas Journal* (London), March 26, pp. 787-8.

"Automatic Coke Hoist." *D. C. Cross.* A novel form of equipment for use with water gas apparatus. *Gas Journal* (London), March 26, 1924, pp. 788-789.

## Readers' Views

### *Exhibition of Applied Photography*

*To the Editor of Chem. & Met.:*

SIR—The Royal Photographic Society of Great Britain is holding its sixty-ninth annual exhibition in September and October of this year. This is the most representative exhibition of photographic work in the world, and the section sent by American scientific men heretofore has sufficiently demonstrated the place held by this country in applied photography. It is very desirable that American scientific photography should be equally well represented in 1924, and in order to enable this to be done with as little difficulty as possible, I have arranged to collect and forward American work intended for the scientific section.

This work should consist of prints showing the use of photography for scientific purposes and its application to spectroscopy, astronomy, radiography, biology, etc. Photographs should reach me not later than Saturday, June 14. They should be mounted but not framed. There are no fees.

I should be glad if any worker who is able to send photographs will communicate with me as soon as possible so that I may arrange for the receiving and entry of the exhibit.

A. J. NEWTON.

Eastman Kodak Co.,
Rochester, N. Y.

## Calendar

AMERICAN ASSOCIATION OF CEREAL CHEMISTS, Curtis Hotel, Minneapolis, Minn., June 9 to 14.

AMERICAN CERAMIC SOCIETY, summer meeting and tour, July 21 to Aug. 18.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, Denver, Colo., July 15 to 18.

AMERICAN LEATHER CHEMISTS ASSOCIATION, Spring Lake, N. J., June 18 to 20.

AMERICAN OIL CHEMISTS SOCIETY, New Orleans, La., May 5 and 6.

AMERICAN PAPER AND PULP MILL SUPERINTENDENTS ASSOCIATION, Dayton, May 22 to 24.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Cleveland, Ohio, May 26 to 29.

AMERICAN SOCIETY FOR STEEL TREATING, Moline, Ill., May 22 to 23.

AMERICAN SOCIETY FOR TESTING MATERIALS, Atlantic City, June 23 to 28.

AMERICAN ZINC INSTITUTE, Hotel Chase, St. Louis, Mo., April 28 and 29.

CANADIAN INSTITUTE OF CHEMISTS, Queens University, Kingston, Ont., May 27 to 29.

MANUFACTURING CHEMISTS ASSOCIATION, annual meeting, India House, New York City, June 4.

NATIONAL ASSOCIATION OF PURCHASING AGENTS, Boston, May 19 to 24.

NATIONAL FERTILIZER ASSOCIATION, Kenilworth Inn, Asheville, N. C., June 9 to 14.

NATIONAL FIRE PROTECTION ASSOCIATION, annual meeting, Atlantic City, N. J., May 13 to 15.

NATIONAL LIME ASSOCIATION, White Sulphur Springs, W. Va., May 20 to 23.

WORLD POWER CONFERENCE, London, June 30 to July 12.

SOCIETY OF INDUSTRIAL ENGINEERS, Buffalo, April 30 to May 2.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION, Boulder, Colo., June 25 to 26.

# News of the Industry

## Summary of the Week

Court holds that the U. S. Tariff Commission must regard trade secrets as confidential.

Pulp and paper manufacturers file memorandum with Royal Commission protesting against proposed embargo on pulpwood shipments from Canada.

American Chemical Society indorses plans for the establishment of a national institute for research in colloid chemistry.

Plant for fixing of atmospheric nitrogen began operation about April 15.

Hooker interests at hearing before Senate committee outline proposed plans for operating Muscle Shoals.

Representatives of dye manufacturers and consumers discuss program for standardization of dyestuffs.

Census figures indicate that domestic production of coal-tar dyes reached record totals in 1923.

### U. S. Paper Men State Case to Royal Commission

A memorandum on behalf of the pulp and paper manufacturers of the United States, summarizing the argument against the proposed imposition of an embargo on pulpwood exported to the United States, has been filed with the Royal Commission which has been investigating for the past 4 months the whole question of an embargo.

In summarizing the evidence presented before the commission, the memorandum asserts that for the dominion as a whole about 90 per cent of the forest area is publicly owned or crown lands, while in the Province of Quebec, from which most of the exports of pulpwood go to the United States, 94 per cent of the forest area is crown land. Since in practically all the provinces there is a prohibition against the export of wood from crown lands, it is pointed out that any embargo would affect less than 10 per cent of the whole forest area, and what wood is now exported is only from lands owned by farmers and settlers or from lands owned in freehold by manufacturers in the United States, or from leases which have been granted by owners in Canada to manufacturers in the United States.

Going at some length into statistics in regard to exports, the memorandum states that the proposed embargo would affect only 1.7 per cent of the total lumber cut, if farmers' and settlers' lands were exempted from the embargo as provided for by an order-in-council passed last year. Furthermore, considering the fact that this order-in-council exempts from the operation of any embargo all contracts given prior to June 15, 1923, for a period of 10 years, the actual percentage of the total wood cut, to which any embargo would apply, would actually be 1 per cent or less than 1 per cent of the total cut, or somewhere between 100,000 or 150,000 cords per year.

Dealing with the argument that the placing of an embargo upon exportation of pulpwood would result in mills from the United States moving immediately to Canada, the memorandum goes at some length into existing economic conditions in respect to the feasibility of moving American plants into Canada, and declares that an examination into facts and conditions is a complete refutation of this contention. The memorandum says: "Pulp and paper mills will be established in the United States and Canada wherever proper sites can be found and proper conditions exist, but the growth of this industry will be the results of economic laws and not the result of statute laws."

### *Standardization of Dyes*

A meeting of the advisory committee on the standardization of dyestuffs was held at the Bureau of Standards in Washington last Wednesday. The purpose of the meeting was to arrange and develop a program with a view of standardizing dyestuffs, with especial reference to fastness to light and washing, methods of test, purchase and kindred matters. Discussion was largely of a preliminary nature, and further meetings will be held so as to arrive at definite standards as soon as possible.

### Casale Plant Making Nitrates

Elon H. Hooker announced before the Senate Committee on Agriculture that the Casale process plant for fixing of atmospheric nitrogen began operation at Niagara Falls about April 15. The Hooker Electrochemical Co., which is in immediate charge of operations, has been so well pleased with the results, so Mr. Hooker stated, that the capacity of the plant is to be doubled immediately.

### Colloid Institute Indorsed by A.C.S.

Plans for the establishment of a National Institute for Research in Colloid Chemistry, announced in the April 7 issue of *Chem. & Met.*, received the enthusiastic indorsement of the council of the American Chemical Society at its meeting in Washington last week. Following are the resolutions passed:

Whereas, in the development of many branches of chemistry, biology, medicine, agriculture, physics, geology and the industries, colloid chemistry plays an increasingly important rôle, and

Whereas, the study of colloid chemistry in America has not been given the attention that its importance deserves, and which must be given if the chemical industries of America are to retain their hard earned independence, and

Whereas, for the proper intensive study of colloid chemistry very specialized equipment is necessary, much of which remains to be designed and built, and

Whereas, it is desirable that fundamental researches be prosecuted under the direction of highly skilled specialists working under the most favorable conditions, and

Whereas, it is necessary that the number of trained workers in colloid chemistry be increased, and

Whereas, the committee on the chemistry of colloids of the National Research Council has, after thorough and careful study, formulated a plan for the establishment of a National Institute for Research in Colloid Chemistry which has secured the approval of the National Research Council and of the National Academy of Sciences, be it

Resolved, that the council of the American Chemical Society approves the plan submitted by the committee on the chemistry of colloids of the National Research Council and pledges its moral support to this committee in its efforts to bring about an early consummation of the plan developed by the committee.

# News in Brief

**To Hold Materials Handling Hearing**—A public hearing with users of materials handling equipment will be held during the spring meeting of the A.S.M.E. by the special committee of the materials handling division on the preparation of formulas for computing economies of labor-saving equipment. A public hearing was held last December with manufacturers of such equipment. Through these two public hearings comments of both sides upon the composition and application of the formulas will be available for making them, when issued, as representative of present practice as possible. Any user of materials handling equipment is invited to attend the meeting in Cleveland, May 28.

**Merger of Glass and Paint Companies**—The Standard Plate Glass Corporation has purchased the Watson Paint & Glass Co. of Pittsburgh and the latter will be merged into the standard corporation. The Watson Paint & Glass Co., which was formed in 1902, is a large producer of paints and varnishes and a distributor of plate and window glass, with nine distributing warehouses in various parts of the country.

**Will Operate Silica Gel Plant**—The Vacuum Oil Co., New York, is making ready to operate its new silica gel plant at Paulsboro, N. J., making the second such unit of its kind to be placed in service. Preliminary tests, it is stated, have proved entirely satisfactory, and it is expected that commercial production will be under way by May 15. The silica gel process at the refinery will be used both for refining lubricating oils and gasoline, as well as for transformer oils, in which latter production it seems destined to be particularly effective. The Vacuum company is one of the Standard Oil Co. group.

**Ontario Restricts Paper Mills**—Licenses for paper and pulp mills located in Ontario, Canada, will be the requirement from now on. This rule has been established because it is felt that in this way the province can prevent saturation of the market and the building of too many plants in one locality.

**T. A. Boyd Addresses Chemists**—The April meeting of the Kansas City Section of the American Chemical Society was held in the assembly room of the Chamber of Commerce, on April 19. T. A. Boyd of the General Motors Corporation spoke on "Ethyl Gas and Chemistry of Anti-Knock Compounds." In view of the interest of the subject to engineers and automotive people, invitations were extended to the local societies of these industries.

**Results of Paint Tests**—Lead, even traces, should be absent from paints that will be exposed to hydrogen sulphide and ammonium sulphide, the Bureau of Standards finds. A cobalt drier is recommended for such conditions. Lithopone is found to be a suitable pigment for interior paints and mixtures of titanium pigment and zinc oxide are good for exterior paints. The tests on which these conclusions are based consisted of exposing the paints to the fumes of hydrogen and ammonium sulphides.

**Eastman Kodak Co. Ordered to End Monopoly**—An order to break up an alleged monopoly of the motion picture film industry was issued last week by the Federal Trade Commission against the Eastman Kodak Co. The commission declared it found that the Eastman company had a substantially complete monopoly of the manufacture of positive cinematograph film. The commission prohibited acquisition by the Eastman company of the Paragon Laboratory, the G. M. Laboratory and the San Jacq Laboratory.

**General Taylor Next Chief of Engineers**—Brigadier-General Harry Taylor is to be the next Chief of Engineers of the U. S. Army. Colonel Edgar Jadwin will succeed General Taylor as Assistant Chief of Engineers. An announcement to the foregoing effect was made by the Secretary of War on April 23. Major-General Lansing H. Beach, the present Chief of Engineers, reaches the retirement age on June 18, when he will be succeeded by General Taylor.

**Chair of Gas Engineering**—Final details are being perfected to finance the establishment of a chair of gas engineering at Johns Hopkins University, Baltimore, Md., and it will stand largely to the credit of the Southern Gas Association for the successful culmination of the plan. The State of Maryland has oversubscribed its quota of the fund for the chair by 50 per cent, and other Southern states have also been active in their support. The committee in charge of the project, all members of the association, are Edward L. Rieha (president of the organization), E. S. Dickey and L. I. Pollitt, all of Baltimore; R. J. Hole, Greensboro, N. C.; B. B. Ferguson, Portsmouth, Va.; and Irwin Rawson, St. Louis, Mo.

## Synthetic Ammonia Production Growing in Spain

According to a Reuter despatch just received the Sociedad Ibérica del Nitrógeno, which has been formed with a capital of 6,500,000 pesetas by a group of Madrid, Barcelona and Santander financiers, expects during 1924 to begin operation of the works under construction at Felguera (Oviedo) for the manufacture of anhydrous ammonia and sulphate of ammonia, with the object of restricting the importation of nitrate from Chile and ammonia from Great Britain. The Claude process is to be employed.

The Sociedad Energia e Industria Aragonesa, which produces chlorates of potash and soda, explosives, dyes and calcium carbide, has already started the manufacture of ammonia and, it is said, can turn out up to 20,000 tons of sulphate of ammonia yearly.

## Cylinder Handling Rules Available for Posting

The Gas Products Association's rules for safe handling of cylinders, published in *Chem. & Met.*, April 7, 1924, p. 545, are now available in printed form suitable for posting on bulletin boards, on the walls of welding shops and wherever cylinders of compressed gases are handled. Copies may be obtained from C. T. Price, secretary, Gas Products Association, 140 South Dearborn St., Chicago, Ill.

## German Oil Companies Merge

It is reported that an amalgamation of three important German oil concerns has recently been effected, they being the Riebecksche Montanwerke, Aktiengesellschaft für Seeschiffahrt und Ueberseehandel and the Aktiengesellschaft für Petroleum-industrie (Api). The first named company produced 26,600 metric tons of mineral oils in 1921-22, as well as 9,700 metric tons of candles, paraffin and mineral wax. The second concern owns oil fields in Argentina and tankers, storage plants, etc., and controls a number of trading companies. The Api company operates the Bergen patents for liquefying coals into oils, for which purpose it has a plant at Heidelberg capable of dealing with 100,000 metric tons a year, and also controls refineries, storage plants and oil fields in Hanover.

## Chicago Company Acquires Control of Trenton Potteries

The Crane Co., Chicago, Ill., manufacturer of plumbing equipment, etc., has acquired a controlling interest in the Trenton Potteries Co., Trenton, N. J., manufacturer of sanitary ware, and affiliated local potteries devoted to the same character of production. It is said that the acquisition will mean early expansion in manufacturing at the different plants. The purchasing company heretofore has been in controlling ownership with the Trenton company of the Mutual Potteries Co., one of the local group, and which plant is now being enlarged for about 50 per cent advance in output. Other potteries affected by the purchase are the Crescent Pottery, Delaware Pottery, Empire Pottery, Enterprise Pottery and the Equitable Pottery.

## March Exports of Cottonseed Oil and Fats Decrease

Compared with the same month last year, the exports of cottonseed oil and fats during March showed a decline. Exports of cottonseed oil in March amounted to 3,999,000 lb., against 4,399,000 lb. a year ago. Lard compound shipments to foreign lands fell off sharply, the total for the month reaching 1,335,000 lb., compared with 4,577,000 lb. a year ago. Oleo oil exports were 8,088,000 lb., compared with 10,648,000 lb. in March, 1923. Pure lard exports, according to the Commerce Department, were 100,726,000 lb., compared with 109,187,000 lb. in March a year ago.

# Washington News

## Tariff Commission Upheld in Nitrite of Soda Case

The Tariff Commission is a fact-finding and not a judicial body and the organic law governing its functions clearly defines that the commission shall regard as confidential trade secrets and information given it by industries, according to a ruling of the District of Columbia Supreme Court.

The court, in this decision, dismissed the demurrer filed by counsel for the Norwegian Nitrogen Products Co., New York, seeking to have the commission's answer to its petition for mandamus dismissed as insufficient. The answer of the commission that its rulings as to making information public are final was upheld by the court. Counsel for the Norwegian company have 3 weeks in which to appeal from this decision on the demurrer, or to elect to try on its merits the original petition for mandamus.

Justice Siddons, rendering the decision, did not touch upon the constitutionality of the flexible provisions of the tariff act, which the Norwegian company also attempted to raise as an issue in its bill.

The Norwegian Nitrogen Products Co., as American selling agent for Norwegian producers of sodium nitrite, has been opposing an increase in duty of that chemical under the flexible tariff on application of the American Nitrogen Products Co., Seattle, Wash. When the public hearing on this application was held, the Norwegian company asked permission to see the cost of production data gathered by agents of the commission from domestic manufacturers. These data were declared confidential by the commission, as practically all figures were secured from a single company, the American Nitrogen Products Co., and to disclose them would be making the business of this corporation public, the commission held. Although the Norwegian producers had refused cost of production figures to agents of the commission in Norway last summer, the selling agency petitioned for a writ of mandamus to compel the commission to disclose to it the domestic data.

## Large Output of Aluminum Salts in 1923

The Department of the Interior announces that the production of aluminum salts in 1923 was 289,904 short tons, valued at $8,987,420, as compared with 281,480 tons, valued at $8,813,000, in 1922. The aluminum industry consumed 211,565 long tons of bauxite in 1923, as compared with 162,980 tons in 1922. It is not possible to give figures showing the quantity of aluminum salts made from clay in 1923, owing to the unwillingness of one of the largest producers in the country to supply a statement showing his output.

Five companies reported a production of 4 766 short tons of ammonia alum, valued at $327,017, and three companies reported a production of 8,061 tons of potash and sodium alum, valued at $465,147, in 1923.

Four companies produced 5,362 short tons of aluminum chloride, valued at $654,580, in 1923. The greater part of this was sold in the anhydrous form.

Commercial aluminum sulphate was made and sold by fifteen companies. The total production in 1923 was 246,095 short tons, valued at $6,354,315, as compared with 231,387 short tons, valued at $6,090,166, in 1922. Four municipal water-purification works produced 4,303 short tons of "Hoover alum" in 1923, as compared with nine plants which made 6,075 tons in 1922.

Iron-free aluminum sulphate was made by five companies in 1923. The output was 16,007 short tons, valued at $676,680, as compared with 19,160 tons, valued at $968,650, in 1922.

## Sulphuric Acid Freight Rates Held Unreasonable

In the case of the Seaboard By-Product Coke Co., the Interstate Commerce Commission has ruled that freight rates on certain movements of sulphuric acid from Grasselli and Brills, N. J., to Seaboard, N. J., were unreasonable to the extent that they exceeded 10.5c. per 100 lb. In the course of the decision, this paragraph appears:

"Complainant performs the terminal service at its plant, which is located on the Hackensack River. Its local traffic amounts to about 2,000,000 tons annually, consisting chiefly of coal, lime and sulphuric acid inbound, and coke, crude oil, tar, sulphate of ammonia and coal gas outbound. Sulphuric acid is used by complainant in the manufacture of sulphate of ammonia. It receives most of its supply of sulphuric acid by water and rarely uses the rail facilities for this traffic when the water route is available. It only resorted to the rail route in this instance for the purpose of securing expedited service in emergencies."

## Favorable Multi-Unit Car Rates Hold

An application of transportation companies for a rehearing and re-argument in the case of the Mathieson multi-unit tank car has been refused by the Interstate Commerce Commission.

In a decision dated Jan. 31, 1924, the commission approved the multi-unit car for the shipment of liquid chlorine and ruled that this car was entitled to the same freight rates and privileges as any other tank car. The commission now refuses to change this ruling.

More than 2 years previous to this decision, when the Mathieson Alkali Works, Inc., placed this specially designed car in service, the carriers refused to allow it tank car rates and privileges. The Mathieson company appealed to the Interstate Commerce Commission for removal of this discrimination and up to the time of the recent favorable ruling was forced to pay out a total of more than $200,000 in excess freight charges in order to continue shipping liquid chlorine in the multi-unit car.

## Larger Production of Glues in 1923

The Department of Commerce announces that according to the reports made to the Bureau of the Census there was produced during the year 1923, 109,061,762 lb. of glue of animal origin as compared with 94,640,981 lb. in 1922, an increase of 15.2 per cent; 39,164,680 lb. of other glues, fish, vegetable, flexible, casein, etc., as compared with 41,254,432 lb. in 1922, a decrease of 5.1 per cent; and 15,617,060 lb. of gelatin of animal origin as compared with 15,223,669 lb. in 1922, an increase of 2.6 per cent.

The production is that of 66 establishments in 1923 as compared with 61 establishments reporting in 1922.

The statistics for 1923 in comparison with 1922 are summarized in the following statement:

| | 1923 | | 1922 |
|---|---|---|---|
| | No. of Establishments | Lb. | Lb. |
| Glues of animal origin | .. | 109,061,762 | 94,640,981 |
| Hide glue | 34 | 64,757,479 | 57,891,041 |
| Extracted bone glue | 14 | 24,428,758 | 8,532,893 |
| Other bone glue | 7 | 19,875,525 | 28,217,047 |
| Other glues | .. | 39,164,680 | 41,254,432 |
| Flexible glue | 10 | 832,784 | 604,838 |
| Vegetable glue | 10 | 32,704,321 | |
| Fish glue | 5 | | 40,649,594 |
| All other, including casein | 4 | 5,627,575 | |
| Gelatin of animal origin | .. | 15,617,060 | 15,223,669 |
| Edible | 12 | 13,321,618 | 13,242,615 |
| Other than edible | 6 | 2,295,442 | 1,981,054 |

## French Potash Production

A report from Paris to the Department of Commerce states that in January there was extracted from the French mines 125,914 metric tons of potassium salt, representing 27,487 tons of pure potash. The following table shows the December, 1923, and January, 1924, extractions:

| | Dec. Tons | Jan. Tons |
|---|---|---|
| Crude salt, 12 to 16 per cent | 72,618 | 61,646 |
| Fertilizer salt, 20-22 per cent | 36,202 | 41,960 |
| Fertilizer salt, 30-40 per cent | 15,912 | 9,795 |
| Chlorides exceeding 50 per cent | 9,101 | 12,513 |

## Competitive Examinations for Bureau of Standards

The United States Civil Service Commission announces open competitive examinations for engineer ($3,800-$5,000), associate engineer ($3,000-$3,600) and assistant engineer ($2,400-$3,000). From the successful candidates will be selected engineers to fill vacancies in the Bureau of Standards, Department of Commerce. Further details and application blank form No. 2118 can be secured from the Civil Service Commission, Washington, D. C. Applications will be received up to and including July 1, 1924.

# Senate Committee Holds Hearings on Muscle Shoals Offers

## Hooker Interests Outline Proposed Plans of Operation—Predict Large Returns to Government on 50-Year Lease

NOT only would the Hooker-White-Atterbury bid for Muscle Shoals contemplate production of nitrogen for commercial fertilizer at low cost, but the corporation would produce calcium arsenate, paradichlor and other insecticides for use in agriculture and horticulture and would continue research studies for further chemical developments along these lines, according to testimony before the Senate Committee on Agriculture and Forestry, which is conducting hearings regarding disposition of the government's projects on the Tennessee River.

The testimony regarding the chemical ambitions of the bidders was given by Elon H. Hooker, president of the Hooker Electrochemical Co., Niagara Falls, and also president of the Manufacturing Chemists Association of the United States, and by Albert H. Hooker, chief chemist and technical director of the Hooker Electrochemical Co.

### Hooker Would Make Fertilizer

Elon H. Hooker told the committee that a highly concentrated fertilizer can be produced at Muscle Shoals and sold on a basis that would save farmers $30,000,000 in 50 years, while at the same time helping the soil greatly because of its plant food value. He said that fertilizer and power operations together would yield the government a return of $305,000,000 in 56 years, figuring 6 years for the completion of the entire power project, with a 50-year lease thereafter. Construction of dam No. 3 should be undertaken at once and completed in 6 years to give the maximum power development, he declared.

Albert H. Hooker told the committee that at first the proposed corporation would use about 110,000 hp. in its chemical works, producing nitrogen and by-products or allied products, but that as the demand for electric power developed in the territory which might be served through a superpower system, this consumption at the plant would be reduced to 10,000 or 12,000 hp., coke and water gas being substituted for electric energy in the chemical works.

### Insecticides Can Be Produced

Paradichlor, a product from chlorine, is a gas that has been found effective in destruction of the peach borer, this witness told the committee, and can be produced in connection with the nitrogen operations. Calcium arsenate for use in combating the cotton boll weevil also can be produced in similar manner, he said. Mr. Hooker further testified that research for a specific for extermination of wheat rust and tobacco wildfire has been conducted at the Niagara Falls plant and would be continued.

F. R. Weller, a consulting engineer of Washington retained by the Hooker-White-Atterbury bidders, told the committee that returns to the government under this bid would be $305,000,000, compared with $136,400,000 under the offer of the Alabama Power Co. and associated companies, and to $90,980,000 under the Ford bid reduced to 56 years. In this estimate Mr. Weller calculated the return to the government from the sale of fertilizer at $85,526,000, the remainder to come from sales of power.

Opposition to all private bids for Muscle Shoals was voiced before the committee by C. F. Graff, president of the American Nitrogen Products Co., Seattle, Wash., on the ground that any private interest getting such favorable terms would in effect receive a subsidy from the government against which no other private corporation could compete successfully.

### Ford Offer Criticised

The Ford bid was attacked by R. D. Bowen, national lecturer for the Non-Partisan League, who said that if the offer as it passed the House were finally accepted by Congress, that body would be "selling the nation's birthright."

W. W. Atterbury, vice-president of the Pennsylvania Railroad, one of the associated bidders, said his interest was in the possibility of producing at low cost what he described as a new metal, an alloy of aluminum and magnesium, for use in railroad cars to lighten their weight. J. G. White, the third associate in the Hooker bid, told the committee that power at Muscle Shoals could be sold at $20 to $40 per horsepower-year.

### Ford's Engineer to Testify

W. B. Mayo, engineer for Henry Ford, will appear before the committee before the hearings close, it having been decided to ask Mr. Ford or an authorized representative to testify regarding disputed points in his bid.

## Opportunities in the Foreign Trade

*Parties interested in any of the following opportunities may obtain all available information from the Bureau of Foreign and Domestic Commerce at Washington or from any district office of the bureau. The number placed after the opportunity must be given for the purpose of identification.*

CAUSTIC SODA. Pernambuco, Brazil. Agency.—9946.

CAUSTIC SODA, cream of tartar, glucose, rosin, soda ash and turpentine. Auckland, New Zealand. Purchase and agency.—9946.

ROSIN. Pernambuco, Brazil. Agency.—9946.

LARD COMPOUND. San Juan, Porto Rico. Agency.—9933.

LINSEED CAKE, in 50-ton consignments. Milan, Italy. Agency.—9945.

PARAFFIN for candle making. Tsingtau, China. Purchase.—9956.

PARAFFIN, pure, for match making. Antwerp, Belgium. Purchase.—9957.

LAUNDRY SOAP. San Juan, Porto Rico. Agency.—9933.

SOAP. Nairobi, British East Africa. Agency.—9899.

## Trade Notes

Production of phosphates in Algeria in 1923 was 467,448 tons, as compared with 482,305 tons in 1922.

Clarence Kendall, a member of the firm of H. J. Baker & Bro., died suddenly on April 19 at his home in New York City. Mr. Kendall had been identified with the fertilizer and chemical industry for 20 years.

The Krebs Pigment Chemical Co. of Wilmington, Del., has increased its capital stock from $2,000,000 to $3,000,000.

J. E. Bonnabeau, who was connected with the general sales department of The Barrett Co., is now with the benzol department of that company.

Allowance of drawback on flavoring extracts manufactured by the Sothness Company, of Chicago, with the use of domestic tax-paid alcohol has been approved by the Treasury Department.

J. C. Francesconi & Co., have leased the building at 12 Water St., New York, and expect to occupy it about May 1.

Andrew M. Sherrill, senior member of the Welch, Holme & Clark Co., of New York, has returned from the Pacific Coast, where he passed the winter.

A dye house and chemical laboratory will be erected by the Debrah Silk Co., Allegany, Pa., and Shinston, W. Va., in connection with a branch plant to be built at Buffalo, N. Y.

Julian B. Beaty has been elected president of the Linndale Reduction Co. of Cleveland, and E. H. Simonson has been chosen secretary and treasurer. Both these men are connected with the Nichols Copper Co.

A growers' association in South Africa plans to undertake the erection and operation of cotton ginning plants, according to recent reports.

## Creditors of Virginia-Carolina Chemical Co. Organize

Two committees have been formed to protect the interests of creditors of the Virginia-Carolina Chemical Co. and the Southern Cotton Oil Co. United action is urged on the part of bank creditors and merchandise creditors. The committee representing the merchandise creditors of the Virginia-Carolina Chemical Co. consist of Albert Wadday, Richmond, Va.; Gilbert C. Halsted, Jr., Walter T. Lindsay, Bernard O. Graves, and James H. Tully, secretary, of New York City. The Southern Cotton Oil committee includes R. H. Ismon, American Can Co.; Paul W. Alexander, Wessel, Duval & Co.; H. A. Vincent, Continental Can Co.; W. J. Pierpont, Pierpont Manufacturing Co., and L. P. Reed, secretary.

It was stated that George K. Morrow is proceeding with the reorganization of the Southern Cotton Oil Co., but that it would be some time before the details of the plan could be decided upon.

# Domestic Output of Coal-Tar Dyes in 1923 Reached Record Totals

### Production Exceeded That for 1922 by 42 Per Cent—Many New Dyes Are Included in Census Returns

THE preliminary figures obtained by the United States Tariff Commission for the domestic production of coal-tar dyes indicate an output of about 92,000,000 lb. in 1923, with a value of about $50,000,000. This is a record output in the history of the industry, and exceeds that of 1920, a year of worldwide business activity when the United States had a large export trade in dyes, prior to the reappearance of German dyes in the world's markets.

The 1923 production exceeds by 42 per cent that of 1922. The contrast of the present industry with that of 1914 is apparent when consideration is taken of the output of 1914, which was only 6,619,729 lb., valued at $2,470,096. The industry of that period consisted largely of assembling plants where intermediates, imported chiefly from Germany, were converted into dyes.

The two factors largely responsible for the increase in 1923, compared with 1922 were: (1) The greater activity of the textile and other dye-consuming industries; (2) the increase in our exports due to the reduced production by the German dye plants during 1923, following the occupation of the Ruhr by the French in the early part of that year.

Indigo leads all dyes in the quantity of production, totaling in 1923 about 28,000,000 lb., compared with 15,850,752 lb. in 1922.

Sulphur black totaled in 1923 about 16,000,000 lb., compared with 12,877,649 lb. in the previous year. The output of Direct black E. W. in 1923 was nearly 7,000,000 lb., a 30 per cent increase over that of 1922, while the output of Agalma black 10 B was about 2,500,000 lb., a 50 per cent increase over the previous year.

#### Progress in Production of New Dyes

During 1923 the variety of domestic dyes was increased by the production for the first time of many new dyes. These include dyes of high fastness, the importance of which is increasing as the consumer of dyes more fully appreciates the importance of fast colors. The new dyes comprise colors for the dyeing of silk, wool and cotton. The production of these new dyes of greater complexity represents a creditable advancement in the industry. The industry is still deficient to a slight extent in the production of a limited number of vat and other dyes which are now imported.

The average sales price of dyes during 1923 was $0.54 per lb., compared with $0.60 in 1922 and $1.26 in 1917. The 1923 sales price is a 10 per cent decline from that of 1922. The average sales price of dyes produced in Great Britain during 1922 is reported to be $0.76 per pound, compared with the domestic price of $0.60 for the same year.

The production of intermediates in 1923 was about 230,000,000 lb., compared with 165,048,155 lb. made in 1922. The preliminary production figures of some of the leading intermediates was as follows: Aniline oil, over 26,000,000 lb.; H acid, about 3,500,000 lb.; phthalic acid and anhydride, over 2,000,000 lb.; anthraquinone, over 800,000 lb.

The preliminary figures for the imports of dyes into the United States during 1923 indicate an importation of 3,100,000 lb., with a value of $3,200,000, as compared with our imports of 3,982,631 lb., valued at $5,243,258, for 1922. Of the total imports of 1923, 47 per cent came from Germany, 28 per cent from Switzerland, 12 per cent from Italy, 6 per cent from France, 4 per cent from the United Kingdom and 3 per cent from all other countries. Prior to the war about nine-tenths of the dyes consumed in the United States were imported, whereas over nine-tenths of the domestic consumption is now produced in the United States.

#### Exports of Dyes Increase

The exports of coal-tar dyes during 1923 show a significant increase as compared with those of the previous year, totaling for 1923, 17,924,200 lb., valued at $5,565,267, as against 8,344,187 lb., with a value of $3,996,443, for 1922. The value of exports in 1923 is an 81 per cent decline from 1920, when our exports reached the maximum of $29,823,591. This was a boom year and represented conditions before German dyes had reappeared in the large consuming markets of the world.

The increase in 1923 of exports of dyes may be largely accounted for by the restricted exports of dyes by Germany due to political conditions and the occupation of the Ruhr by the French. The German dye production for 1923 was 25 per cent less than for 1922. In the latter part of 1923 the monthly output of dyes by Germany was steadily increasing and German dyes are recently reported to be offering sharp competition to the domestic and British dyes in the markets of the Far East.

## Coast Oil Production Maintained

The daily average crude oil production of California for the month of March was 642,363 bbl., compared with 666,939 bbl. for the month of February, according to the American Petroleum Institute. Total stocks of crude oil, residuum and tops held in California at the end of March were 96,666,719 bbl., compared with 95,460,505 bbl. at the end of February. There were 131 wells completed in March with an initial daily production of 62,771 bbl., compared with 102 wells completed in February with an initial daily production of 44,471 bbl.

## Financial

The board of directors of the International Oxygen Co., of Newark, N. J., has declared a dividend of $3 a share on all outstanding stock.

The United Dyewood Corporation for the year ended Dec. 31, 1923, reports a net income of $1,547,023, after deducting depreciation, interest, taxes, etc. This is equivalent, after allowing for the preferred dividends, to $9.31 a share on the $13,918,300 common stock outstanding.

The directors of the Westinghouse Electric & Manufacturing Co. have voted to increase the capital stock from $125,000,000 to $200,000,000, the increase to consist of common stock. The proposition will be submitted to the stockholders at the annual meeting June 11 at Pittsburgh.

The Sherwin-Williams Co. has declared an extra dividend of 12½c. and regular quarterly dividend of 50c. on common stock, also the regular quarterly dividend of 1¾ per cent on the first preferred A stock.

## Latest Quotations on Industrial Stocks

| | Last Week | This Week |
|---|---|---|
| Air Reduction | 73¼ | 70¾ |
| Allied Chem. & Dye | 65¼ | 68¾ |
| Allied Chem. & Dye pfd | 109 | 113 |
| Am. Ag. Chem. | 9 | 8½ |
| Am. Ag. Chem. pfd | 24½ | 23½ |
| American Cyanamid | *96 | *94 |
| Am. Drug Synd | 4⅞ | 4⅞ |
| Am. Linseed Co | 16 | 15½ |
| Am. Linseed pfd | 34 | *35 |
| Am. Smelting & Refining Co | 60⅞ | 60⅞ |
| Am. Smelting & Refining pfd | 98½ | 98 |
| Archer-Daniels Mid. Co. w.i. | 22 | 21 |
| Archer-Daniels Mid. Co. pfd | *85½ | 85 |
| Atlas Powder | *51 | *50 |
| Casein Co. of Am. | *65 | *65 |
| Certain-Teed Products | *24 | *30 |
| Commercial Solvents "A" | 49 | 50 |
| Corn Products | 164¾ | 167 |
| Corn Products pfd | *114 | 116⅞ |
| Davison Chem. | 46½ | 43⅞ |
| Dow Chem. Co. | *45 | *45 |
| Du Pont de Nemours | 122 | 119⅞ |
| Du Pont de Nemours db | 88 | 86 |
| Freeport-Texas Sulphur | 10 | 8¾ |
| Gold Dust | 31 | 31 |
| Grasselli Chem. | *125 | *125 |
| Grasselli Chem. pfd | *102 | *102 |
| Hercules Powder | 102 | 99 |
| Hercules Powder pfd | 105 | 104 |
| Heyden Chem. | 1½ | 1¼ |
| Int'l Ag. Chem. Co. (new) | 3¾ | 4 |
| Int'l Ag. Chem. pfd | 4⅝ | 5½ |
| Int'l Nickel | 12⅝ | 12 |
| Int'l Nickel pfd | 80 | 80 |
| Int'l Salt | 89¼ | *88 |
| Mathieson Alkali | *33 | 32½ |
| Merck & Co. | 65 | *65 |
| National Lead | 132½ | 127¾ |
| National Lead pfd | *112½ | *111 |
| New Jersey Zinc | *149 | *140 |
| Parke, Davis & Co | *80 | *80 |
| Pennsylvania Salt | *85 | *85 |
| Procter & Gamble | *127 | *127 |
| Sherwin-Williams | 31½ | 30½ |
| Sherwin-Williams pfd | *103½ | 103 |
| Tenn. Copper & Chem | 7½ | 7 |
| Texas Gulf Sulphur | 58⅝ | 57¾ |
| Union Carbide | 57¾ | 57 |
| United Drug | 76 | 75 |
| United Dyewood | *40 | *40 |
| U. S. Industrial Alcohol | 67 | 65¼ |
| U. S. Industrial Alcohol pfd | 101 | 100½ |
| Va.-Car. Chem. Co | 1⅞ | 2 |
| Va.-Car. Chem. pfd | 6 | 6⅞ |

*Nominal. Other quotations based on last sale.

# Men You Should Know About

F. J. BATES is in Europe as a representative of the Bureau of Standards at the fiftieth anniversary of the Physical Society of London. While abroad he will study sugar laboratory and research work on the Continent as well as in England.

HOWARD E. BEEDY, vice-president and general manager of the Nashwaak Pulp & Paper Co., St. John, N. B., recently left on an extended trip to Europe, where he will investigate chemical pulp plants in Norway, Sweden, Finland and other countries.

Major FREDERCK E. BREITHUT, now in Vienna, Austria, on work for the Bureau of Foreign and Domestic Commerce, is drawing his work to a conclusion, expecting to be back in the United States by July 1.

A. COPELAND CALLEN, of the University of West Virginia, has been selected to head the department of mining engineering at the University of Illinois. The position has remained open since the death of Prof. H. H. Stoeck on March 1, 1923.

CHARLES A. COFFIN, founder of the General Electric Co., Schenectady, N. Y., and former president, has been awarded a certificate of honorary membership in the Franklin Institute, Philadelphia, Pa., in recognition of his achievements in the electrical industry.

HALSEY DURAND of Newark, N. J., has received a temporary appointment as city chemist, succeeding HERBERT B. BALDWIN, who recently retired after serving for more than 30 years. Mr. Durand is a graduate of Princeton University and for some time was connected with the New York Health Department as an assistant chemist.

GRAHAM EDGAR, who has been professor of chemistry in the University of Virginia, has resigned to join the staff of the General Motors Research Corporation, Dayton, Ohio, where he will organize a division of physical chemistry.

ERNEST HOPKINSON, vice-president of the United States Rubber Co., delivered a lecture on the rubber industry before the engineering students at Princeton University, Princeton, N. J., April 12.

A. M. KENNEDY is now with the Gulf States Chemical & Refining Co. at Montgomery, Ala.

EARL KIRCHNER of Washington, D. C., has been elected president of the Lehigh Chemical Society.

MAX KNOBEL, formerly at the Massachusetts Institute of Technology and later at the University of California, is now with Guggenheim Bros., New York City.

Dr. VICTOR C. MYERS, formerly director of the department of biochemistry in the New York Post-Graduate Medical School, has been elected professor of biochemistry at the University of Iowa and will assume his duties at Iowa City next fall.

JOHN A. OARTEL, safety director of the Carnegie Steel Co., gave an address on the subject of "Safety," before the senior class in the College of Industries, Carnegie Institute of Technology, Pittsburgh, Pa., April 11.

TALBOT E. PIERCE, for many years superintendent of the Semet-Solvay Co., Cleveland, Ohio, has severed his connection with the organization and is now located at Waterford, Logan County, Va.

Dr. CHARLES L. REESE, chemical director of E. I. du Pont de Nemours & Co., Inc., has retired from the active duties of this position, although he will remain in the company's employ in a consulting capacity. Doctor Reese's retirement follows 22 years of active service with the du Pont organization. His successor as chemical director will be his former assistant, Dr. C. M. STINE.

WILHELM SEGERBLOM, head of the department of chemistry at Phillips-Exeter Academy, Exeter, N. H., was made an honorary member of the New England Association of Chemistry Teachers at its twenty-fifth anniversary meeting held recently at Malden, Mass. This honor was conferred in recognition of his services to the association and to the cause of chemistry teaching.

ATHERTON SEIDELL sails May 2 for Bordeaux, France, as an American delegate to the meeting of the Société de Chemie Industrielle.

Dr. M. SEM, chemical engineer with the Norske Eleckrokemisk Industri, Christiania, Norway, addressed the chemical engineering students of Columbia University on the electrochemical and electrometallurgical industries of Norway, on March 25, 1924.

Prof. WALTER T. TAGGART has been appointed by President Hinckley as the American Electrochemical Society's representative to the International Congress of Pure and Applied Chemistry at Copenhagen, in June, 1924.

ERNEST T. TRIGG, head of the John T. Lewis Brothers Co., Philadelphia, Pa., manufacturer of paints and varnish, has been appointed chairman of the industrial relations committee of the local Chamber of Commerce for the ensuing year.

Dr. L. B. TUCKERMAN, engineer physicist of the Bureau of Standards, Washington, D. C., gave an address before the members of the Engineers Club, Baltimore, Md., April 16, on the subject "The Work of the Materials and Structural Testing Laboratory of the Bureau of Standards."

FLOYD B. WHITE, heretofore secretary of the Interstate Oil Corporation, Los Angeles, Calif., has been elected president, succeeding D. W. Wickersham, who met death recently in an automobile accident.

W. L. WOTHERSPOON has been appointed consulting engineer for the International Nickel Co., Huntington, W. Va.

C. A. YOUNG who has severed his connection with the Lucey Manufacturing Corporation, has been appointed to take charge of the standardization work for the American Petroleum Institute and to carry it on in accordance with resolutions adopted at the annual meeting of the Institute at St. Louis.

## Obituary

D. D. CHRISTIE, president of the Standard White Lime Co., Guelph, Ont., died suddenly at his home in Guelph, in his 85th year. Mr. Christie was also president of the Christie Henderson Co., Toronto, the Ontario Lime Co., Toronto, and the Winnipeg Supply & Fuel Co.

JAMES DUNLOP, founder and director of Canadian Tube & Steel Products, Ltd., died at his home in Montreal on April 3. Mr. Dunlop was born in 1855 and for 43 years had been connected with the iron and steel industry.

J. M. IVERSON, kraft superintendent of the St. Maurice Paper Co., Cape Madeleine, died in a Montreal hospital, March 28. He was 61 years of age and a pioneer in the kraft industry of Canada.

SENECA LEWIS, vice-president and general manager of the Pennsylvania Rubber Co., died at Greensburg, Pa. April 15. Mr. Lewis had been with the company since 1910.

JOHN T. MORROW, consulting engineer, formerly general manager of the Greene Consolidated Copper Co. at Cananea, Mexico, died recently at his home in Harmon, N. Y. His widow and three daughters survive. Mr. Morrow was born at Bangor, Me., in 1865 and was graduated in 1889 from Lehigh University with the degree of mechanical engineer, later receiving the degree of electrical engineer from the same university. After 4 years with the Edison and General Electric companies he went to Great Falls, Mont., where he became superintendent of the Boston & Montana Reduction Works. In 1903 he took the post at Cananea, and on coming to New York later opened an office as consulting engineer and served from time to time such important interests as the Bethlehem Steel Co., the Pearson properties in the City of Mexico and the General Electric Co. At the time of his death he had an office at 25 Church St.

GEORGE W. WHEELWRIGHT, prominently identified with the New England paper-manufacturing industry, died at the Charlesgate Hospital, Boston, Mass., April 12, aged 79 years. He was head of the George W. Wheelwright Paper Co., of the same city, and had spent practically his entire business life in this line of endeavor. Mr. Wheelwright is survived by five sons and a daughter.

# Market Conditions

## Numerous Price Changes Reported in Market for Chemicals

### Revised Quotations Favor Buyers—Decline in Acetate of Lime Has Far Reaching Effect

TRADING in chemicals during the past week was marked by downward revisions in many selections. Quiet call for stocks which has featured the market for several weeks has had a weakening effect on values and lower prices are said to have been named in order to stimulate buying.

There was scarcely any change in the position of consuming trades and call for fresh commitments continues along quiet lines. Contract deliveries are good and in some cases have shown improvement since the first of the month. Some sellers say that withdrawals in March were not up to expectations and that activity this month has been created by the fact that consumers have been working on small stocks.

The weighted index for the week shows a material decline, resting at 156.88 as compared with 157.62 for the preceding week. The trend of prices so far this year as indicated by the weighted index has been directly opposite to what it was last year. The number was influenced in the past week by the lower sales prices for numerous chemicals and allied materials.

Among the important reductions was a decline of one-half cent per lb. in the quotation for acetate of lime. The new figure became effective at the beginning of the week. The drop in price was attributed to the fact that stocks on hand have been increasing and demand had been slowed up in expectation of a lower price schedule. Other declines followed as a result of the reduction in acetate of lime.

Arrivals of chemicals from foreign markets were again large and keen competition is reported between the foreign and domestic products. Reports from Germany state that conditions there are not favorable and that local conditions tend to keep prices high and the margin of profits low. It is further stated that some chemical plants have greatly curtailed production because they find it unprofitable to compete under existing conditions.

#### Acids

More than ordinary interest was attracted to acids last week by reason of price changes. The decline in acetate of lime was directly responsible for a lowering in quotations for all grades of acetic acid. The latter has been holding at relatively high levels as some competing materials were offered at terms more favorable to buyers. The new prices are expected to favor a more active consuming demand. Oxalic acid has steadied a little in some quarters but spot offerings are still available at 10⅜c. per lb. and competition is keen enough to prevent any sustained stability to values. Imported offerings of citric acid have been free and spot sales are reported at 47c. per lb. The mineral acids are in fair demand but are none too steady in price and sellers are said to be carrying large supplies.

**Lower Prices for Acetate of Lime, Acetate of Lead, Acetone, Acetic Acid, Ethyl Acetate, Methyl Acetate—Arsenic Quiet and Easy—Sulphate of Ammonia Lower—Caustic Potash Firmer for Shipment—Resale Lots of Bleaching Powder Reported**

#### Potashes

**Bichromate of Potash** — Call for moderate sized lots is said to be improving but there is no real activity in the market. Offerings are in firm hands and full quotation prices are being realized on sales. Resale lots are not prominent and producers quote 9½c. per lb. and upward on a quantity basis.

**Caustic Potash**—This material has been featured by a firmer market for future deliveries. Offerings for shipment from abroad are said to be held at an inside figure of 6½c. per lb. with 7c. per lb. asked in other quarters. Demand for spot goods has been quiet and while 6¾@7c. per lb. is generally asked, it was possible to buy at 6⅝c. per lb.

**Permanganate of Potash**—Practically all the buying has been for prompt delivery. Prices have shown a range according to seller. Domestic permanganate is still offered at 14@14½c. per lb. at works, the range depending on quantity. Some importers are meeting the domestic price and are offering at 14c. per lb. in the spot market.

**Prussiate of Potash**—Some inquiry has been noted for yellow prussiate of potash and reports have been heard that sales have been made at private terms. The open quotation is 18½@19c. per lb. for spot goods but it is stated that 18c. per lb. could be done. Red prussiate also was unsteady in price with the market favoring buyers, as the asking prices have ranged from 38c. to 40c. per lb.

#### Sodas

**Acetate of Soda** — There is a fair movement against contracts and call for additional lots also has made progress. Asking prices of 5c. per lb. and upward on a quantity basis are said to be close to producing costs and this gives a steady tone to values.

**Bichromate of Soda**—Most of the large buyers are covered ahead and this accounts for the preponderance of small lot buying. Trading is reported to have expanded in the past 2 weeks but is hardly up to normal owing to the backward position of consuming industries. There has been no change in prices for some time and in the absence of competitive selling it is easy to hold quotations on a stable basis. Quotations are 7½@7¾c. per lb.

**Caustic Soda** — Details on export shipments show that by far the largest amounts shipped out in January and February were destined for Mexico. In February the Argentine took second place away from Canada, which held that position in January. Cuba, Japan, and Brazil ranked next. The open quotation for export is 3@3.05c. per lb., f.a.s. New York, but this can be shaded. Domestic consumers have been ordering out material more freely this month and total shipments to date are said to be larger than in April last year. Prices for domestic delivery are steady at 3.10c. per lb., on contract.

**Fluoride of Soda**—Domestic fluoride is in a nominal position and buying is confined to the imported. The latter has been finding a good outlet both for spot and forward. Spot fluoride is offered at 9@9½c. per lb. and shipments at 8¾c. per lb.

**Nitrite of Soda** — Unconfirmed reports were heard last week to the effect that recommendations for an increase in duty would soon be made by the Tariff Commission. These reports may have arisen from the fact that a court decision upheld the contention that producing costs of domestic makers as reported to the commission were to be held confidential. Demand for nitrite has been quiet and consumers for the most part are covered ahead. It is possible that 8c. per lb. could be done but the quotation is 8¼@8½c. per lb.

**Prussiate of Soda**—It still remains a buyers' market and trading is too quiet to bring about any upward revision of prices. Imported prussiate is offered freely on spot and 10c. per lb. represents the views of sellers. Shipments from abroad are offered on a laid down basis of 9¾c. per lb. They also are not attracting much attention.

### Miscellaneous Chemicals

**Acetate of Lead**—Owing to a reduction in producing costs, all grades of acetate of lead were marked down in price in the past week. The new quotations are on a basis of 13½c. per lb. for brown, broken, in bbl., 13.90c. per lb. for white, broken, 14.15c. per lb. for white, granular, 14½c. per lb. for white, crystals, and 15¼c. per lb. for white, powdered.

**Acetate of Lime**—Demand for this material has been falling behind the totals of production and sellers have been accumulating stocks. This condition has created an unhealthy market and effective last Monday a lower selling price became effective. Sellers now offer acetate of lime at $3 per 100 lb.

**Acetone**—There has been considerable competition in this material with some producers said to be favored by lower costs of production. Price concessions have been granted in recent trading and open quotations were brought down during the week to conform with the actual trading basis. The new quotations range from 15c. to 16c. per lb.

**Arsenic**—Rather heavy arrivals from abroad were noted last week and sales are said to have been made at different prices on an ex-dock basis. Buying in the spot market has not improved to any extent and the tone remains easy with asking prices subject to bids from buyers. The open quotation for spot holdings of imported arsenic is 10c. per lb. Domestic arsenic is held at 11c. per lb. but producers describe the market as stagnant. Japanese arsenic for May-June shipment from the other side is offered at 8c. per lb. but this is not proving attractive. Calcium arsenate is passing against old orders but new business is small although reports from the South say that considerable quantities have sold at 11½c. per lb. in carlots and 12c. per lb. for less than carlots. Prompt shipment from works can be bought at 11c. per lb. for carlots.

**Bleaching Powder**—About the only development in this material is found in reports that resale offerings have appeared in the market at prices lower than those quoted by first hands. It is generally expected that prices will weaken during the hot weather period but prominent factors say that there will be no repetition of conditions which existed last summer.

**Formaldehyde** — While sellers are making a distinction in price between carlots and smaller amounts, the asking price has been irregular and sales of carlots at 10⅝c. per lb. had been made prior to the decline from 11c. per lb. which was announced in the preceding week. Demand is fairly good for both large and small lots.

**Copper Sulphate**—Imported sulphate has been offered more freely in the spot market and prices have tapered off as a result. Spot holdings were available at 4½c. per lb. Shipments from abroad were quoted at 4⅝c. per lb. Domestic sulphate was held at 4.85@4.95c. per lb.

**Sulphate of Ammonia**—In spite of reports that large buying for the season was over, there has been a fairly good call for fresh supplies. Export inquiry also is said to have been of larger volume. Sellers have tried to induce buying by holding prices at relatively low levels and asking prices have declined to $2.70 per 100 lb. for round lots.

**Tin Oxide**—While reports are still heard to the effect that there is a difference in price according to seller, the tone has been steadier owing to recoveries in the metal market. The general asking price for oxide is 55c. per lb.

### "Chem. & Met." Weighted Index of Chemical Prices

Base = 100 for 1913-14

| | |
|---|---|
| This week | **156.88** |
| Last week | 157.62 |
| April, 1923 | 180.00 |
| April, 1922 | 158.00 |
| April, 1921 | 140.00 |
| April, 1920 | 261.00 |
| April, 1919 | 231.00 |
| April, 1918 | 286.00 |

Lower prices for acetic acid, ammonium sulphate, acetone, calcium acetate and crude cottonseed oil are reflected in the 74 point decline in the weighted index number.

### Alcohol

First hands reported a steady situation in denatured alcohol. Business was not active, but deliveries against existing contracts were large and this kept supplies from accumulating. The firm position of basic materials also was a supporting factor. Completely denatured, formula No. 5, held nominally at 44½c. per gal. There was no change in the market for U.S.P. ethyl spirits.

Butyl alcohol was in larger supply and producers offered material at 25@30c. per lb.

Methanol was unsettled, but no open change in prices took place. On the 95 per cent grade, 93c. was asked, cooperage basis. Pure methanol, tank cars, was offered freely at 90c., works.

# Coal-Tar Products

## Census Figures Indicate Larger Output of Intermediates for 1923—Market for Crudes Holds Firm

THE preliminary report of the United States Tariff Commission on production of coal-tar intermediates and dyes for 1923 indicated that the industry made even greater progress than predicted by trade authorities. According to the statement, the output of intermediates reached the total of 230,000,000 lb., compared with 165,048,155 lb. in 1922 and 70,899,912 lb. in 1921. The average price obtained for coal-tar dyes registered a decline of 10 per cent, the average being 54c. per lb., against 60c. per lb. in 1922.

Price changes in coal-tar products during the week were few and unimportant. Producers reported moderate stocks of crudes, and a firm undertone featured the market for benzene, toluene and solvent naphtha. In some quarters a rather weak tone prevails in U.S.P. phenol and it was intimated that contract business could be worked at lower levels. There was a fair call for refined naphthalene, but prices were irregular on liberal offerings. Pyridine was steady on smaller offerings from abroad.

**Aniline Oil**—A steady undertone prevailed in producing circles and 16c. appeared to be an inside price on round-lot transactions, immediate and forward delivery. Production of aniline oil in 1923, according to the Tariff Commission, amounted to 26,000,000 lb., which compares with 21,401,864 lb. in 1922.

**Benzaldehyde** — With competition more of a factor, the market on the technical grade was unsettled, prices ranging from 68@70c. per lb., in drums.

**Benzene**—The action of the market for gasoline has been disappointing and the prospects for higher prices for benzene do not look so bright. However, producers say that there is enough call for the motor fuel grade to absorb the entire output, and the tone of the market remains firm. The 90 per cent grade held at 23c. per gal., tank cars, works, and at 28c. per gal., in drums. The usual premium obtains for the pure grade.

**Cresylic Acid**—Supplies are ample for ordinary needs of the trade, and with consumers not disposed to buy ahead, the market remains unsettled. Quotations range from 65@70c. per gal. on the 95@97 per cent material. Foreign markets for crude were fairly steady. Several parcels of crude material arrived here during the week from British ports.

**Dinitrobenzene**—Lower prices were named in some quarters, a little selling pressure being apparent at times. Quotations now range from 16@18c. per lb.

**H Acid**—Demand was inactive and prices unsettled at 72@78c. per lb. Production of H acid in 1923 was placed at 3,500,000 lb., compared with 2,208,657 lb. in 1922.

**Naphthalene** — Offerings of refined naphthalene, especially flake, were sufficient to bring out sharp competition for business and further unsettlement in prices. On carload transactions buyers could have obtained supplies around 5½c. per lb. Chips closed nominally at 4¾@5c. per lb. Crude for shipment from abroad was offered at 2@2¼c. per lb., c.i.f. basis.

**Paranitraniline**—There were sellers at prices ranging from 68@72c. per lb., the inside figure holding on round lots. Demand was quiet.

**Phenol**—The market was inactive and an easy undertone was in evidence in more than one quarter. U.S.P. phenol was available for immediate delivery at 28c. per lb., while on futures 26c. was regarded as a nominal price only.

**Pyridine**—Spot material was in firm hands, nominal quotations ranging from $4.40@$4.50 per gal. On shipment material $4.25 was asked, with offerings smaller.

# Vegetable Oils and Fats

## Crude Cottonseed Slightly Lower—China Wood Advances—Heavy Imports of Olive Foots—Tallow Active and Higher

SLIGHTLY lower prices for crude cottonseed oil attracted buyers and business placed in the South absorbed all free offerings. Linseed oil for immediate shipment was firm, but futures were irregular, with sentiment mostly bearish. China wood oil advanced on smaller offerings of nearby material.

**Cottonseed Oil**—The feature in the market was the Census Bureau report on cottonseed products covering the August-March period. The report indicated disappearance of refined oil for the month of March of 162,000 bbl., which compares with 153,000 bbl. in February and 165,000 bbl. for March a year ago. Traders were somewhat disappointed in the showing, but did not lose hope in the future as no extravagant claims were made as regards March business. In the case case of April, however, the situation is different and distribution of approximately 200,000 bbl. is anticipated. Deliveries of oil and compound over the first half of April were large, but the moderate advance in prices, together with cheap offerings of lard, has checked new business. The distribution of refined oil for the 8 months ended March 31 was 272,000 bbl. less than for the corresponding period a year ago. The visible supply of oil, including seed on hand converted into the refined product, at the close of March amounted to 948,000 bbl., which compares with 840,000 bbl. a year ago. Receipts of seed during March were larger than a year ago. In the past week crude oil sold at 8⅝c. per lb., tank cars, Southeast, and 8½c. per lb., in Texas, compound makers being the principal buyers. Refined oil in the option market went off about 20 points on liquidation of May contracts. April 28 will be the first tender day for May contracts and about 5,000 bbl. may be delivered, according to traders. Lard compound was quiet, but held nominally at 12@12¼c. per lb., carload basis.

**Coconut Oil**—Not much new business was reported in coconut oil. Deliveries on contract were large and stocks of unsold oil are not burdensome. With copra comparatively firm producers were not anxious to force selling. Ceylon type oil was offered at 8c. per lb., tank cars, Pacific coast points, and at 8½c. per lb., tank cars, New York, all positions. Manila sundried copra held at 5c. per lb., c.i.f. Pacific coast ports, nearby positions.

**Linseed Oil**—Business placed since the first of the month shows a substantial gain, contrasted with the same period in March, but this is no unusual occurrence, as April is regarded as one of the best months for the linseed oil trade. But buyers did not anticipate in their wants, most of the sales calling for April-May delivery. The market during the past week was steady on prompt business and 90c. per gal. was asked in nearly all quarters, carload basis, cooperage included. May oil was offered at 89c. per gal., same terms, and May-June at 88c. per gal. On June forward the inside figure could have been shaded. Developments in the flaxseed situation were unimportant. There was good buying of nearby Argentine seed by American crushers. May shipment in the Buenos Aires option market held at $1.57 per bu. At Duluth domestic seed for May shipment showed little change for the week, holding around $2.38 per bu. The mills in the Northwest are preparing to close down for the season. Linseed oil mills located in the New York district will be called upon to ship oil to points West, and, to meet this extra demand production will be augmented in this territory. In the past week two small parcels of linseed oil arrived from abroad. Linseed cake for May shipment from New York settled at $34 per ton. Stocks of seed at Minneapolis on April 19 amounted to 104,507 bu., which compares with 6,112 bu. a year ago.

### *Receipts of Cottonseed in March, 92,353 Tons*

Arrival of cottonseed at the mills in March amounted to 92,353 tons, compared with 51,865 tons a year ago. Consumption of refined cottonseed oil for the 8 months ended March 31 amounted to 1,486,000 bbl., against 1,758,000 bbl. for the corresponding period a year ago. Cottonseed statistics for the 8 months, with a comparison, follow:

| | August-March | |
|---|---|---|
| | 1923-24 | 1922-23 |
| Seed received, ton | 3,204,372 | 3,164,828 |
| Seed crushed, ton | 2,975,591 | 3,019,262 |
| Crude oil mfd., lb. | 876,594,668 | 927,059,088 |
| Ref'd. oil mfd., lb. | 671,530,063 | 779,068,020 |
| Stocks March 31: | | |
| Seed, ton | 234,121 | 154,013 |
| Crude oil, lb. | 110,115,460 | 59,328,113 |
| Ref'd. oil, lb. | 215,062,233 | 239,925,080 |
| Exports, 8 months: | | |
| Crude oil, lb. | 20,658,547 | 21,733,205 |
| Refined oil, lb. | 10,268,241 | 31,561,242 |
| Cake and meal, tons | 92,007 | 208,810 |

**China Wood Oil**—With cables higher and less pressure on spot the market steadied. Bids at 14½c. per lb., in bbl., immediate delivery, were turned down, and at the close asking prices ranged from 14¾@15¼c. per lb. On the Pacific coast 13¼@13½c. per lb., tank car basis, represented the market for nearby material. Inquiry for nearby oil was good.

**Soya Bean Oil**—Crude soya for May shipment from the Pacific coast was offered at 9⅜c. per lb., tank cars, duty paid. In New York the market was nominal at 10½c., tank cars, immediate shipment.

**Olive Foots**—Arrivals were large and some selling pressure was in evidence for ex-dock material, sales passing at close to 9½c. per lb. Closing prices were nominal at 9¾@10c. per lb., according to delivery and seller.

**Palm Oils**—Offerings of futures increased and prices were barely steady. Lagos oil for shipment was available at 7@7⅛c. per lb., with Bonny-Old Calabar at 6⅞c. and Niger at 6½@6⅝c. Lagos on spot was scarce and prices nominal at 7½@8c. per lb.

**Rapeseed Oil**—Cables were higher, April shipment from England advancing to 84c. per gal., with May at 82c. per gal., and June forward at 80c. per gal. Spot oil held at 90@92c. per gal., in bbl. Demand good.

**Sesame Oil**—Refined oil firm at 11@11½c. per lb., in bbl., prompt and forward shipment.

**Tallow, Etc.**—Sales of close to 2,000,000 of extra tallow went through at 7½c. per lb., f.o.b. plant, an advance of ½c. per lb. Choice yellow grease was in steady request and higher prices prevailed, the market settling at 7@7¼c. per lb. Oleo stearine sold for export at 10⅜c. per lb.

## Miscellaneous Materials

**Antimony** — There were sellers of Chinese at 9⅜c. per lb. Cookson's "C" grade unchanged at 12½c. per lb. Chinese needle, lump, nominal at 8½@9c. per lb. Antimony oxide 9½@10c. per lb. Trading inactive and tone barely steady.

**Dry Colors** — Firmer prices were named by leading handlers of carbon black. On contract carbon gas was held at 9@11c. per lb., according to grade. Spot material, in cases, settled at 12@16c. per lb. Prussian blues were offered freely at 40@45c. per lb. English vermilion was raised to $1.35 per lb., in sympathy with the higher market for quicksilver.

**Feldspar**—In North Carolina No. 1 crude held at $6.50@$7.50 per ton, with No. 2 grade at $4.50@$5 per ton.

**Glycerine** — Chemically pure barely steady at 17c. per lb., in drums, carload lots. Demand routine only. Dynamite steady at 16½c. per lb. asked, with no sales reported. Crude offerings moderate and market firm at 11c. per lb. on soaplye, basis 80 per cent, loose, carload lots, f.o.b. point of shipment.

**Naval Stores** — Turpentine easy on lack of important buying. Offerings ex-yard New York reported at 90c. per gal., which compares with 98c. a week ago. Export demand slow and new crop offerings increasing. Rosin in fair demand and nominally unchanged on the basis of $5.80 per bbl. for lower grades.

**Lithopone**—The movement of lithopone into consuming channels good and prices continue steady on the basis of 6⅝c. per lb., carload lots, in bags, nearby delivery.

**White Lead** — The official contract price for pig lead held at 8½c. per lb., but sales at lower levels in the outside market were put through at 7.90c. per lb. The recent decline in the metal has eased the situation in pigments to some extent, but corroders did not alter the selling schedule. The leading seller announced that the guarantee against decline had been extended to Aug. 31. Standard dry white lead is quoted at 10½c. per lb., in casks, carload basis.

**Zinc Oxide** — The demand was fair and, with no important change in the metal, prices were quotably unchanged. American process, lead free, held at 7⅞c. per lb., carload lots. French process, red seal, steady at 9⅞c. per lb.

# Imports at the Port of New York

**April 18 to April 24**

**ACIDS—Cresylic**—71 dr., Liverpool, W. E. Jordan & Bro.; 30 dr., Glasgow, Order. **Formic**—140 cs., Rotterdam, R. W. Greeff & Co. **Tartaric**—100 csk., Rotterdam, Chemical National Bank; 50 bbl. and 50 keg. Rotterdam, W. Benkert & Co.; 20 csk., Rotterdam, Hans Heinrich Chemical Co.; 100 csk., Rotterdam, Chemical National Bank; 100 csk., Rotterdam, Order.

**AMMONIUM BROMIDE**—20 cs., Hamburg, Order.

**AMMONIUM CHLORIDE** — 112 csk., Hamburg, Order.

**AMMONIUM CARBONATE** — 10 bbl., Liverpool, Order.

**ANTIMONY REGULUS**—750 cs., Shanghai, Wah Chang Trading Corp.; 100 cs., Hankow, Irving Bank-Col. Trust Co.

**ANTIMONY SULPHIDE**—7 csk., Southampton, L. H. Butcher & Co.; 200 bbl., Havre, Heemsoth, Basse & Co.

**ANTHRACENE**—50 dr., London, Order.

**ARSENIC** — 200 cs., Shanghai, Wah Chang Trading Corp.; 200 cs., Kobe, G. Wills & Sons; 200 cs., Kobe, Gravely & Co.; 400 cs., Kobe, J. D. Lewis; 130 cs., Kobe, M. H. Graced, Inc.; 800 cs., Kobe, Travelly & Co.; 200 cs., Kobe, P. E. Falkingham; 490 cs., Kobe, Herrick & Voight; 250 cs., Kobe, Takata & Co.; 250 cs., Kobe, Suzuki & Co.; 200 cs., Kobe, Shima Trading Co.; 160 cs., Kobe, Frazer & Co.; 500 cs., Kobe, J. D. Lewis; 200 csk., Hamburg, Central Union Trust Co.; 465 bbl., Tampico, American Smelting & Refining Co.

**BARIUM CARBONATE**—170 bg., Hamburg, Seaboard National Bank; 55 pkg., Rotterdam, Meteor Products Co.

**BARIUM CHLORIDE** — 44 csk., Hamburg, Roessler & Hasslacher Chemical Co.

**BARIUM NITRATE**—57 csk., Hamburg, Meteor Products Co.; 28 csk., Hamburg, Philadelphia National Bank; 125 csk., Rotterdam, Philadelphia Natl. Bank; 58 csk., Rotterdam, Jungmann & Co.; 148 csk., Rotterdam, Meteor Products Co.

**BARIUM HYDRATE** — 29 csk., Hamburg, E. Suter & Co.; 21 bbl., Hamburg, Innis, Speiden & Co.

**BARYTES**—117 bbl., Hamburg, Ore & Chemicals Corp.; 300 bg., Rotterdam, E. L. Bullock; 50 csk., Rotterdam, A. Klipstein & Co; 600 bg., Rotterdam, Schall Color & Chemical Co.; 300 bg., Rotterdam, P. Uhlich & Co.

**BAUXITE**—167 tons (in bulk), Paramaribo, A. M. Kohler.

**CALCIUM CHLORIDE**—106 dr., Hamburg, E. Suter & Co.; 307 dr., Hamburg, E. Suter & Co.

**CAMPHOR** — 100 cs. crude, Shanghai, Hetherman & Co.; 50 cs., Shanghai, Dodwell & Co.; 23 bbl. synthetic, Hamburg, Order; 150 cs., Rotterdam, G. W. Sheldon & Co.

**CHALK** — 2,700 bg., Antwerp, Bankers Trust Co.; 590 bg., Stanley Daggett, Inc.; 1,000 tons, Londan, Taintor Trading Co.; 240 bg., London, Brown Bros. & Co.; 800,000 kilos (in bulk), Dunkirk, J. W. Higman & Co.; 500 tons, London, Baring Bros. & Co.; 500 tons, Hull, Taintor Trading Co.; 1,440 bg., Antwerp, Bankers Trust Co.; 300 bg., Antwerp, Equitable Trust Co.

**CHEMICALS** — 55 carboys, Rotterdam, Order; 19 cs., Havre, E. Fougera & Co.; 15 cs., Hamburg, Eimer & Amend; 20 cs., Genoa, Order; 129 dr., Hamburg, Roessler & Hasslacher Chemical Co.; 10 csk., Hamburg, Heemsoth, Basse & Co.; 32 cs., Hamburg, Scientific Materials Co.; 1 cs., Hamburg, Farleigh & Ball; 20 bbl., Hamburg, E. Dietzgen Co.; 27 bbl., Bremen, Stanley, Daggett, Inc.; 53 pkg., Havre, Wallerstein Laboratories; 72 csk., Hamburg, Jungmann & Co.; 280 bg., Glasgow, Coal & Iron National Bank; 374 bg., Glasgow, Brown Bros. & Co.; 12 cs., Hamburg, A. Hurst & Co.; 43 dr. hydrosulphide formaldehyde, Antwerp, E. Ritter.

**COAL-TAR DISTILLATE**—107 dr., Liverpool, Monsanto Chemical Works; 212 dr., Liverpool, Order; 50 dr., Liverpool, Order.

**COLORS**—16 csk. aniline, Genoa, Irving Bank-Col. Trust Co.; 5 pkg. do., Genoa, L. R. Organic Products Co.; 5 cs. do., Genoa, Wetterwald & Pfister Co.; 6 csk. do., Genoa, Order; 14 bbl. aniline, Havre, Ciba Co.; 8 bbl. do., Havre, Carbic Color & Chemical Co.; 3 cs. do., Havre, Sandoz Chemical Works; 5 csk. dry, Hamburg, H. R. Jahn; 19 pkg. aniline, Hamburg, Franklin Import & Export Co.; 10 csk. aniline, Hamburg, Kuttroff, Pickhardt & Co.; 14 csk. do., Hamburg, H. A. Metz & Co.; 8 csk. aniline, Genoa, Irving Bank-Col. Trust Co.; 13 csk. do., Genoa, Mechanics & Metals National Bank; 2 csk., Genoa, Bank of the Manhattan Co.; 4 cs. aniline, Genoa, Wetterwald & Pfister Co.; 8 cs., Genoa, Order; 18 csk. earth, Hamburg, Reichard-Coulston, Inc.; 6 csk. aniline, Antwerp, Am. Exchange National Bank; 5 bbl. do., Antwerp, Bank of the Manhattan Co.

**COPPER SULPHATE**—100 csk., Hamburg, Order; 100 bbl., Hamburg, C. Hardy, Inc.

**DIVI-DIVI**—255 bg., Maracaibo, Order.

**EMERY**—248 tons (in bulk), Smyrna, Order.

**EPSOM SALT**—250 bbl., Hamburg, Order; 200 bbl., Hamburg, Innis, Speiden & Co.

**FUSEL OIL**—28 csk., Hamburg, Order; 5 dr., Dunkirk, Order.

**FULLERS EARTH**—300 bg., London, L. A. Salomon & Bros.

**GLAUBER SALT**—1,000 bg., Bremen, E. Suter & Co.

**GLYCERINE**—100 dr., Rotterdam, Order.

**GUMS**—210 bg. copal, Antwerp, Brown Bros. & Co.; 604 bg. do., Antwerp, W. Schall & Co.; 266 bg. do., Antwerp, Chemical National Bank; 310 bg. do., Antwerp, Order; 21 bg. copal, London, Chemical National Bank; 83 cs. copal, London, African & Eastern Trading Co.; 82 bg. copal, Antwerp, Order.

**IRON OXIDE**—52 csk., Liverpool, J. McNulty; 44 csk., Liverpool, Philipp Bros.; 19 csk., Liverpool, Reichard-Coulston, Inc.

**LITHOPONE** — 100 csk., Hamburg, Bankers Trust Co.; 40 csk., Rotterdam, L. H. Butcher & Co.; 300 csk., Rotterdam, Order.

**MAGNESITE** — 313 bg. and 103 bbl., Rotterdam, Speiden, Whitfield Co.; 105 bbl., Rotterdam, Innis, Speiden & Co.; 470 bbl., Rotterdam, Brown Bros. & Co.

**MAGNESIUM SULPHATE** — 1,000 bg., Hamburg, Order.

**MAGNESIUM CHLORIDE** — 150 dr., Hamburg, D. Blank & Co.

**MYROBALANS**—2,686 bg., Bombay, National City Bank; 5,528 bg., Bombay, Bingham & Co.; 1,524 bg., Bombay, Hammond & Carpenter Co.; 1,200 bg., Bombay, Dexters, Ltd.; 7,601 pkt., Calcutta, National City Bank; 380 bg., Bombay, National City Bank; 1,280 pkt., Calcutta, Order.

**NAPHTHALENE** — 208 bg., Rotterdam, Lunham & Reeve.

**NICKEL SALTS** — 23 bbl., Hamburg, Brown Bros. & Co.

**OILS—Coconut**—1,148 tons (in bulk), Manila, Spencer Kellogg & Sons; 630 tons, Manila, Procter & Gamble Co.; 253 tons, Manila, Copra Milling Co. **China Wood**—260 bbl., Hankow, Mitsui & Co.; 100 dr., London, Order. **Grape Seed**—50 bbl., London, W. B. Dick Co. **Linseed**—29 bbl., London, International Composition Co.; 100 bbl., Antwerp, Order. **Olive Foots** (sulphur oil)—700 bbl., Bari, Palmolive Co.; 200 bbl., Bari, Bank of the Manhattan Co.; 300 bbl., Bari, W. R. Grace & Co.; 400 bbl., Bari, Philadelphia National Bank; 250 bbl., Bari, W. Schall & Co.; 608 tons (in bulk), Bari, Palmolive Co.; 370 bbl., Naples, Banca Comm. Ital. **Perilla**—200 bbl., Dairen, Cook & Swan Co. **Sardine**—1,700 bbl., Kobe, Cook & Swan Co. **Sperm**—50 bbl., Glasgow, Order.

**OIL SEEDS—Castor**—83 bg., Port de Paix, J. L. Hachtmann & Co.; 271 bg., Port de Paix, H. Mann & Co.; 4,278 bg., Bombay, Volkart Bros.; 9,574 bg., Bombay, Order; 3,373 bg., Dairen, I. R. Boody & Co.; 2,139 bg., Bombay, Volkart Bros.; 9,833 bg., Bombay, Order; 8,182 bg., Cocanada, Volkart Bros. **Linseed** — 18,825 bg., Buenos Aires, National City Bank; 17,885 bg., Buenos Aires, Order. **Peanut**—2,000 bg., Tsingtao, Hale & Co.; 1,050 bg., Tsingtao, I. R. Boody & Co.; 3,790 bg., Tsingtao, Order.

**PARIS GREEN** — 100 cs., Hamburg, Order.

**POTASSIUM SALTS**—133 csk. carbonate, Hamburg, Peters, White & Co.; 140 dr. and 101 csk. caustic, Hamburg, A. Klipstein & Co.; 50 dr. caustic, Hamburg, Peters, White & Co.; 711 dr. permanganate, Hamburg, Roessler & Hasslacher Chemical Co.; 55 dr., caustic, Hamburg, A. Klipstein & Co.; 47 csk. carbonate and 529 csk. alum, Hamburg, Order; 40 csk. bromide, Hamburg, Order; 634 csk. alum, Rotterdam, Superfos Co.; 24 csk. carbonate, Bremen, P. H. Petry & Co.

**PYRIDINE**—3 dr., Hamburg, Order.

**PYRITES**—6,153,960 kilos, Huelva, Pyrites Co.

**QUICKSILVER**—88 flasks, Genoa, Order. 112 flasks, Hamburg, Order; 27 flasks, Tampico, Order.

**SAL AMMONIAC** — 67 bbl., Hamburg, J. Munroe & Co.; 36 csk., Hamburg, E. Suter & Co.; 400 csk. chlorate, Hamburg, Mechanics & Metals National Bank; 37 csk., Hamburg, Order; 108 bbl., Hamburg, Order.

**SHELLAC**—100 bg., London, Ralli Bros.; 100 bg. garnet, Hamburg, Kasebier-Chatfield Shellac Co.; 99 cs., London, Order; 18 cs., Rotterdam, Order; 300 pkg., Calcutta, J. Munroe & Co.; 100 bg., Calcutta, British Overseas Bank; 200 bg., Calcutta, Standard Bank of South Africa; 200 bg., Calcutta, MacLeod Co.; 500 bg. and 50 cs., Calcutta, Order; 50 bg., Calcutta, Mitsui & Co.; 125 bg., Calcutta, Standard Bank of South Africa; 100 bg., Calcutta, N. Y. Trust Co.; 750 bg., Calcutta, National City Bank; 100 bg., Calcutta, Arbuthnot, Latham & Co.; 100 bg., Calcutta, First National Bank of Boston; 1507 bg., 314 bg., seedlac, 25 bg. button and 500 bg. refuse, Calcutta, Order.

**SILVER SULPHIDE**—5 cs., Callao, Markt & Schaefer, 12 cs., Callao, American Metal Co.

**SODIUM SALTS**—42 csk. prussiate, Rotterdam, A. Klipstein & Co.; 100 csk. Rotterdam, Meteor Products Co.; 200 bbl. fluoride, Rotterdam, Innis, Speiden & Co.; 21 csk. prussiate, Rotterdam, H. Kohnstamn & Co.; 390 dr. sulphate, Hamburg, G. S. Grant & Co.; 36 csk. fluoride, Hamburg, Globe Shipping Co.; 42 csk. do., Hamburg, E. Suter & Co.; 604 csk. nitrate, Hamburg, Order; 44 csk. prussiate, Hamburg, E. Suter & Co.; 349 csk. nitrite, Hamburg, Order; 20 csk. bromide, Hamburg, Order; 20 csk. prussiate, Liverpool, Order; 16,585 bg. nitrate, Iquique, W. R. Grace & Co.; 3,500 bg. do., Iquique, Anthony Gibbs & Co.; 32,726 bg. do., Iquique, W. R. Grace & Co.; 14,239 bg. do., Antofagasta, W. R. Grace & Co.; 60 cs. cyanide, Liverpool, Am.-British Chemical Supplies Co.

**STRONTIUM NITRATE**—198 csk., Rotterdam, E. Suter & Co.

**TALC**—375 bg., Genoa, L. A. Salomon & Bros.; 200 bg., Genoa, C. Mathieu.

**TARTAR**—37 csk., Naples, Tartar Chemical Co.

**UMBER**—930 bg. raw and 2,184 bg. burnt, Lanaga, Reichard-Coulston, Inc.; 940 bg. burnt, Lanaga, J. Lee Smith & Co.; 45 bg. Trieste, Scott, Libby Corp.

**VALONEA**—7,100 bg., Smyrna, Order.

**VERMILION** — 20 keg., London, Pomeroy & Fischer.

**WOOL GREASE** — 30 bbl., Bremen, Comm'l Sales & Supply Co.; 15 cs., Bremen, Pfaltz & Bauer.

**WAXES**—20 bg. beeswax, Cardenas, Guaranty Trust Co.; 181 bg. carnauba, Ceara, National City Bank; 393 bg. do., Ceara, Lazard Freres; 481 bg. do., Ceara, Order; 4 bg. ozokerite, Trieste, Order; 72 bg. beeswax, Rotterdam, Ponds Extract Co.; 50 cs. do., Rotterdam, Order; 500 bg. montan, Hamburg, Irving Bank-Col. Trust Co.; 225 bg. montan, Hamburg, W. Schall & Co.; 224 bg. beeswax, Valparaiso, National Bank of Commerce; 182 bg. do., Valparaiso, Order; 22 bg. do., Talcahuano, W. R. Grace & Co.; 28 bg. do., Talcahuano, Banco Aleman Transatl.

**WHITING**—5,490 bg., Dunkirk, Taintor Trading Co.

**ZINC OXIDE**—10 cs., London, Order; 100 bbl., Marseilles, Order.

# Current Prices in the New York Market

***For Chemicals, Oils and Allied Products***

THESE prices are for the spot market in New York City, but a special effort has been made to report American manufacturers' quotations whenever available. In many cases these are for material f.o.b. works or on a contract basis and these prices are so designated. Quotations on imported stocks are reported when they are of sufficient importance to have a material effect on the market. Prices quoted in these columns apply to large quantities in original packages.

## General Chemicals

| | | | |
|---|---|---|---|
| Acetone, drums, wks | lb. | $0.15 - | $0.15½ |
| Acetic anhydride, 85%, dr | lb. | .38 - | .... |
| Acid, acetic, 28%, bbl | 100 lb. | 3.12 - | 3.37 |
| Acetic, 56%, bbl | 100 lb. | 5.85 - | 6.10 |
| Acetic, 80%, bbl | 100 lb. | 8.19 - | 8.44 |
| Glacial, 99½%, bbl | 100 lb. | 11.01 - | 11.51 |
| Boric, bbl | lb. | .10 - | .... |
| Citric, kegs | lb. | .45½- | .47 |
| Formic, 85% | lb. | .12½- | .13 |
| Gallic, tech | lb. | .45 - | .50 |
| Hydrofluoric, 52%, carboys | lb. | .11 - | .12 |
| Lactic, 44%, tech., light, bbl | lb. | .12½- | .13 |
| 22% tech., light, bbl | lb. | .06 - | .06½ |
| Muriatic, 18° tanks | 100 lb. | .80 - | .85 |
| Muriatic, 20°, tanks | 100 lb. | .95 - | 1.00 |
| Nitric, 36°, carboys | lb. | .04 - | .04½ |
| Nitric, 42°, carboys | lb. | .04¾- | .05½ |
| Oleum, 20%, tanks | ton | 16.00 - | 17.00 |
| Oxalic, crystals, bbl | lb. | .10½- | .10¾ |
| Phosphoric, 50% carboys | lb. | .07½- | .08½ |
| Pyrogallic, resublimed | lb. | 1.55 - | 1.60 |
| Sulphuric, 60°, tanks | ton | 9.00 - | 10.00 |
| Sulphuric, 60°, drums | ton | 13.00 - | 14.00 |
| Sulphuric, 66°, tanks | ton | 14.00 - | 15.00 |
| Sulphuric, 66° drums | ton | 19.00 - | 20.00 |
| Tannic, U.S.P., bbl | lb. | .65 - | .70 |
| Tannic, tech., bbl | lb. | .45 - | .50 |
| Tartaric, imp., powd., bbl | lb. | .27 - | .28 |
| Tartaric, domestic, bbl | lb. | .30 - | .... |
| Tungstic, per lb | lb. | 1.20 - | 1.25 |
| Alcohol, butyl, drums, f.o.b. works | lb. | .25 - | .30 |
| Alcohol ethyl (Cologne spirit), bbl | gal. | 4.85 - | .... |
| Ethyl, 190 p'f. U.S.P., bbl | gal. | 4.81 - | .... |
| Alcohol, methyl (see Methanol) | | | |
| Alcohol, denatured, 190 proof | | | |
| No. 1, special bbl | gal. | .51½- | ... |
| No. 1, 190 proof, special, dr. | gal. | .45½- | ... |
| No. 1, 188 proof, bbl | gal. | .52½- | ... |
| No. 1, 188 proof, dr | gal. | .48½- | ... |
| No. 5, 188 proof, bbl | gal. | .50½- | ... |
| No. 5, 188 proof, dr | gal. | .44½- | ... |
| Alum, ammonia, lump, bbl | lb. | .03¾- | .04 |
| Potash, lump, bbl | lb. | .03 - | .04 |
| Chrome, lump, potash, bbl. | lb. | .05½- | .06 |
| Aluminum sulphate, com., bags | 100 lb. | 1.40 - | 1.50 |
| Iron free bags | | 2.40 - | 2.50 |
| Aqua ammonia, 26°, drums | lb. | .06½- | .06¾ |
| Ammonia, anhydrous, cyl | lb. | .28 - | .30 |
| Ammonium carbonate, powd. tech., casks | lb. | .12 - | .13 |
| Ammonium nitrate, tech., casks | lb. | .09 - | .10 |
| Amyl acetate tech., drums | gal. | 3.25 - | 3.75 |
| Antimony oxide, white, bbl | lb. | .09½- | .10 |
| Arsenic, white, powd., bbl | lb. | .10 - | .11 |
| Arsenic, red, powd., kegs | lb. | .14½- | .15½ |
| Barium carbonate, bbl | ton | 66.00 - | 68.00 |
| Barium chloride, bbl | ton | 88.00 - | 90.00 |
| Barium dioxide, 88%, drums | lb. | .17½- | .18 |
| Barium nitrate, casks | ... | .08½- | .08¾ |
| Blanc fixe, dry, bbl | lb. | .03½- | .04 |
| Bleaching powder, f.o.b. wks., drums | 100 lb. | 1.90 - | .... |
| Spot N. Y. drums | 100 lb. | 2.25 - | 2.35 |
| Borax, bbl | lb. | .05½- | .05¾ |
| Bromine, cases | lb. | .28 - | .30 |
| Calcium acetate, bags | 100 lb. | 3.00 - | 3.05 |
| Calcium arsenate, dr | lb. | .11 - | .11½ |
| Calcium carbide, drums | lb. | .05 - | .05½ |
| Calcium chloride, fused, dr. wks. | ton | 21.00 - | .... |
| Gran. drums works | ton | 27.00 - | .... |
| Calcium phosphate, mono, bbl | lb. | .06¾- | .07½ |
| Camphor, Jap. cases | lb. | .75 - | .76 |
| Carbon bisulphide, drums | lb. | .06 - | .06½ |
| Carbon tetrachloride, drums | lb. | .07½- | .08 |
| Chalk, precip.—domestic, light, bbl | lb. | .04½- | .04¾ |
| Domestic, heavy, bbl | lb. | .03¾- | .04 |
| Imported, light, bbl | lb. | .04½- | .05 |
| Chlorine, liquid, tanks, wks. | lb. | .04½- | .... |
| Contract, tanks, wks | lb. | .04½- | .... |
| Cylinders, 100 lb., wks | lb. | .05½- | .07½ |
| Chloroform, tech., drums | lb. | .30 - | .32 |
| Cobalt, oxide, bbl | lb. | 2.10 - | 2.25 |
| Copperas, bulk, f.o.b. wks | ton | 16.00 - | 18.00 |
| Copper carbonate, bbl | lb. | .16¾- | .17 |
| Copper cyanide, drums | lb. | .45 - | .46 |
| Coppersulphate, dom., bbl. | 100 lb. | 4.85 - | 5.00 |
| Imp bbl | 100 lb. | 4.50 - | 4.60 |
| Cream of tartar, bbl | lb. | .21 - | .22 |
| Epsom salt, dom., tech., bbl | 100 lb. | 1.75 - | 2.00 |
| Epsom salt, imp., tech., bags | 100 lb. | 1.10 - | 1.20 |
| Epsom salt, U.S.P., dom., bbl | 100 lb. | 2.25 - | 2.50 |
| Ether, U.S.P., dr | lb. | .14 - | .15 |
| Ethyl acetate, 85%, drums. | gal. | .95 - | .... |
| Ethyl acetate, 99%, dr | gal. | $1.10 - | .... |
| Formaldehyde, 40%, bbl | lb. | .10½- | .11 |
| Fullers earth—f.o.b. mines | ton | 7.50 - | 18.00 |
| Furfural, works, bbl | lb. | .25 - | .... |
| Fusel oil, ref., drums | gal. | 3.50 - | .... |
| Fusel oil, crude, drums | gal. | 2.50 - | 2.75 |
| Glaubers salt, wks., bags | 100 lb. | 1.20 - | 1.40 |
| Glaubers salt, imp., bags | 100 lb. | 1.00 - | 1.05 |
| Glycerine, c.p., drums extra | lb. | .17 - | .... |
| Glycerine, dynamite, drums | lb. | .16½- | .... |
| Glycerine, crude 80%, loose | lb. | .11 - | .11½ |
| Hexamethylene, drums | lb. | .68 - | .75 |
| Lead: | | | |
| White, basic carbonate, dry, casks | lb. | .10½- | .... |
| White, basic sulphate, casks | lb. | .09¾- | .... |
| White, in oil, kegs | lb. | .12½- | .... |
| Red, dry, casks | lb. | .12 - | .... |
| Red, in oil, kegs | lb. | .13½- | .... |
| Lead acetate, white crys., bbl. | lb. | .14½- | .... |
| Brown, broken, casks | lb. | .13½- | .... |
| Lead arsenate, powd., bbl | lb. | .18 - | .20 |
| Lime-Hydrated, bg, wks | ton | 10.50 - | 12.50 |
| Bbl., wks | ton | 18.00 - | 19.00 |
| Lime, Lump, bbl | 280 lb. | 3.63 - | 3.65 |
| Litharge, comm., casks | lb. | .11½- | .... |
| Lithopone, bags | lb. | .06½- | .06¾ |
| Magnesium carb., tech., bags | lb. | .08½- | .08¾ |
| Methanol, 95%, bbl | gal. | .93 - | .... |
| Methanol, 97%, bbl | gal. | .95 - | .... |
| Methanol, pure, tanks | gal. | .90 - | .... |
| drums | gal. | 1.00 - | .... |
| bbl | gal. | 1.05 - | .... |
| Methyl-acetone, t'ks | gal. | .85 - | .86 |
| Nickel salt, double, bbl | lb. | .09½- | .10½ |
| Nickel salts, single, bbl | lb. | .10 - | .11 |
| Orange mineral, csk | lb. | .14½- | .15½ |
| Phosgene | .... | .69 - | .75 |
| Phosphorus, red, cases | lb. | .70 - | .75 |
| Phosphorus, yellow, cases | lb. | .35 - | .40 |
| Potassium bichromate, casks | lb. | .09½- | .09¾ |
| Potassium bromide, gran., bbl | lb. | .19 - | .20 |
| Potassium carbonate, 80-85%, calcined, casks | lb. | .05½- | .06 |
| Potassium chlorate, powd | lb. | .07½- | .08½ |
| Potassium cyanide, drums | lb. | .47 - | .52 |
| Potassium, first sorts, cask | lb. | .07¾- | .08 |
| Potassium hydroxide (caustic potash) drums | lb. | .06½- | .06¾ |
| Potassium iodide, cases | lb. | 3.65 - | 3.75 |
| Potassium nitrate, bbl | lb. | .07½- | .09 |
| Potassium permanganate, drums | lb. | .14 - | .14½ |
| Potassium prussiate, red, casks | lb. | .38 - | .42 |
| Potassium prussiate, yellow, casks | lb. | .18½- | .19 |
| Salammoniac, white, gran., casks, imported | lb. | .06¾- | .... |
| Salammoniac, white, gran., bbl., domestic | lb. | .07½- | .07¾ |
| Gray, gran., casks | lb. | .08 - | .09 |
| Salsoda, bbl | 100 lb. | 1.20 | 1.40 |
| Salt cake (bulk) works | ton | 23.00 - | .... |
| Soda ash, light, 58% flat, bulk, contract | 100 lb. | 1.25 - | .... |
| bags, contract | 100 lb. | 1.38 - | .... |
| Soda ash, dense, bulk, contract, basis 58% | 100 lb. | 1.35 - | .... |
| bags, contract | 100 lb. | 1.45 - | .... |
| Soda, caustic, 76%, solid, drums contract | 100 lb. | 3.10 - | .... |
| Soda, caustic, ground and flake, contracts, dr | 100 lb. | 3.50 - | 3.85 |
| Soda, caustic, solid, 76% f. a.s. N. Y | 100 lb. | 3.00 - | .... |
| Sodium acetate, works, bbl | lb. | .05 - | .05½ |
| Sodium bicarbonate, bulk | 100 lb. | 1.75 - | .... |
| 330-lb. bbl | 100 lb. | 2.00 - | .... |
| Sodium bichromate, casks | lb. | .07½- | .07¾ |
| Sodium bisulphate (niter cake) | ton | 6.00 - | 7.00 |
| Sodium bisulphite, powd., U.S.P., bbl | lb. | .04¾- | .04½ |
| Sodium chlorate, kegs | lb. | .06½- | .07 |
| Sodium chloride | long ton | 12.00 - | 13.00 |
| Sodium cyanide, cases | lb. | .19 - | .22 |
| Sodium fluoride, bbl | lb. | $0.09 - | $0.10½ |
| Sodium hyposulphite, bbl | lb. | .02½- | .02¾ |
| Sodium nitrite, casks | lb. | .08½- | .08¾ |
| Sodium peroxide, powd., cases | lb. | .28 - | .30 |
| Sodium phosphate, dibasic, bbl | lb. | .03½- | .03¾ |
| Sodium prussiate, yel. bbl | lb. | .10 - | .12 |
| Sodium salicylic, drums | lb. | .38 - | .40 |
| Sodium silicate (40°, drums) | 100 lb. | .75 - | 1.15 |
| Sodium silicate (60°, drums) | 100 lb. | 1.75 - | 2.00 |
| Sodium sulphide, fused, 60-62% drums | lb. | .03½- | .03¾ |
| Sodium sulphite, crys., bbl | lb. | .03½- | .03¾ |
| Strontium nitrate, powd., bbl. | lb. | .10 - | .10½ |
| Sulphur chloride, yel drums. | lb. | .04½- | .05 |
| Sulphur, crude | ton | 18.00 - | 20.00 |
| At mine, bulk | ton | 16.00 - | 18.00 |
| Sulphur, flour, bag | 100 lb. | 2.25 - | 2.35 |
| Sulphur, roll, bag | 100 lb. | 2.00 - | 2.10 |
| Sulphur dioxide, liquid, cyl | lb. | .08 - | .08 |
| Tin bichloride, bbl | lb. | .14 - | .... |
| Tin oxide, bbl | lb. | .55 - | .... |
| Tin crystals, bbl | lb. | .35½- | .... |
| Zinc carbonate, bags | lb. | .14 - | .14½ |
| Zinc chloride, gran, bbl | lb. | .05 - | .05½ |
| Zinc cyanide, drums | lb. | .36½- | .37 |
| Zinc dust, bbl | lb. | .08 - | .08½ |
| Zinc oxide, lead free, bag | lb. | .07½- | .... |
| 5% lead sulphate, bags | lb. | .07½- | .... |
| 10 to 35 % lead sulphate, bags | lb. | .07 - | .... |
| French, red seal, bags | lb. | .09½- | .... |
| French, green seal, bags | lb. | .10½- | .... |
| French, white seal, bbl | lb. | .12 - | .... |
| Zinc sulphate, bbl | 100 lb. | 3.00 - | 3.25 |

## Coal-Tar Products

| | | | |
|---|---|---|---|
| Alpha-naphthol, crude, bbl | lb. | $0.60 - | $0.65 |
| Alpha-naphthol, ref., bbl | lb. | .70 - | .75 |
| Alpha-naphthylamine, bbl | lb. | .35 - | .36 |
| Aniline oil, drums | lb. | .16 - | .16½ |
| Aniline salts, bbl | lb. | .22 - | .23 |
| Anthracene, 80%, drums | lb. | .75 - | .80 |
| Anthraquinone, 25%, paste, drums | lb. | .75 - | .80 |
| Benzaldehyde U.S.P., carboys | lb. | 1.50 - | .... |
| f.f.c. drums | lb. | 1.60 - | .... |
| tech, drums | lb. | 68 | .72 |
| Benzene, pure, water-white, tanks, works | gal. | .25 - | .... |
| Benzene, 90%, tanks, works | gal. | .23 - | .... |
| Benzidine base, bbl | lb. | .80 - | .82 |
| Benzidine sulphate, bbl | lb. | .70 - | .72 |
| Benzoic acid, U.S.P., kegs | lb. | .82 - | 85 |
| Benzoate of soda, U.S.P., bbl. | lb. | .67 - | .72 |
| Benzyl chloride, 95-97%, ref., carboys | lb. | .35 - | .... |
| Benzyl chloride, tech., drums | lb. | .25 - | .... |
| Beta-naphthol, tech., bbl | lb. | .24 - | .25 |
| Beta-naphthylamine, tech | lb. | .65 - | .70 |
| Cresol, U.S.P., drums | lb. | .23 - | .28 |
| Ortho-cresol, drums | lb. | .28 - | .32 |
| Cresylic acid, 97%, works drums | gal. | .68 - | .72 |
| 95-97%, drums, works | gal. | .65 - | .68 |
| Dichlorbenzene, drums | lb. | .07 - | .08 |
| Diethylaniline, drums | lb. | .53 - | .55 |
| Dimethylaniline, drums | lb. | .36 - | .38 |
| Dinitrobenzene, bbl | lb. | .16 - | .18 |
| Dinitrochlorbenzene, bbl | lb. | .21 - | .22 |
| Dinitronaphthalen, bbl | lb. | .30 - | .32 |
| Dinitrophenol, bbl | lb. | .35 - | .40 |
| Dinitrotoluen, bbl | lb. | .18 - | .20 |
| Dip oil, 25%, drums | gal. | .26 - | .28 |
| Diphenylamine, bbl | lb. | .50 - | .52 |
| H-acid, bbl | lb. | .72 - | .75 |
| Meta-phenylenediamine, bbl. | lb. | .95 - | 1.00 |
| Michlers ketone, bbl | lb. | 3.00 - | 3.50 |
| Monochlorbenzene, drums | lb. | .08 - | .10 |
| Monoethylaniline, drums | lb. | .95 - | 1.10 |
| Naphthalene, flake, bbl | lb. | .05½- | .06 |
| Naphthalene, balls, bbl | lb. | .06½- | .07 |
| Naphthionate of soda, bbl | lb. | .60 - | .65 |
| Naphthionic acid, crude, bbl. | lb. | .60 - | .62 |
| Nitrobenzene, drums | lb. | .09 - | .09½ |
| Nitro-naphthalene, bbl | lb. | .25 - | .30 |
| Nitro-toluene, drums | lb. | .13½- | .14 |
| N-W acid, bbl | lb. | 1.05 - | 1.10 |
| Ortho-amidophenol, kegs | lb. | 2.40 - | 2.50 |
| Ortho-dichlorbenzene, drums | lb. | .12 - | .13 |
| Ortho-nitrophenol, bbl | lb. | 1.25 - | 1.30 |
| Ortho-nitrotoluene, drums | lb. | .11 - | .12 |
| Ortho-toluidine, bbl | lb. | .12 - | .13 |
| Para-aminophenol, base, kegs | lb. | 1.25 - | 1.35 |
| Para-aminophenol, HCl, kegs | lb. | 1.45 - | 1.60 |
| Para-dichlorbenzene, bbl | lb. | .17 - | 20 |
| Paranitraniline, bbl | lb. | .68 - | .70 |
| Para-nitrotoluene, bbl | lb. | .58 - | .60 |
| Para-phenylenediamine, bbl. | lb. | 1.40 - | 1.50 |
| Para-toluidine, bbl | lb. | .74 - | .82 |
| Phthalic anhydride, bbl | lb. | .30 - | .34 |
| Phenol, U.S.P., dr | lb. | .26 - | .28 |
| Picric acid, bbl | lb. | .20 - | 22 |
| Pitch, tanks, works | ton | 25.00 - | 30.00 |
| Pyridine, imp., drums | gal. | 4.45 - | 4.55 |
| Resorcinol, tech., kegs | lb. | 1.30 - | 1.40 |

| | | |
|---|---|---|
| Resorcinol, pure, kegs | lb. | $2.05 - $2.10 |
| R-salt, bbl. | lb. | .55 - .60 |
| Salicylic acid, tech., bbl. | lb. | .32 - .33 |
| Salicylic acid, U.S.P., bbl. | lb. | .35 - .... |
| Solvent naphtha, water-white, tanks | gal. | .25 - .... |
| Crude, tanks | gal. | .22 - .... |
| Sulphanilic acid, crude, bbl. | lb. | .16 - .18 |
| Tolidine, bbl. | lb. | 1.00 - 1.05 |
| Toluidine, mixed, kegs | lb. | .30 - .35 |
| Toluene, tank cars, works | gal. | .26 - .... |
| Toluene, drums, works | gal. | .30 - .... |
| Xylidine, drums | lb. | .50 - .... |
| Xylene, pure, tanks | gal. | .40 - .... |
| Xylene, com., tanks | gal. | .28 - .... |

## Naval Stores

| | | |
|---|---|---|
| Rosin B-D, bbl. | 280 lb. | $5.80 - .... |
| Rosin E-I, bbl. | 280 lb. | 5.80 - .... |
| Rosin K-N, bbl. | 280 lb. | 5.90 - $6.10 |
| Rosin W.G.-W.W., bbl. | 280 lb. | 7.00 - 7.40 |
| Wood rosin, bbl. | 280 lb. | 5.80 - 5.90 |
| Turpentine, spirits of, bbl. | gal. | .93½ - .... |
| Wood, steam dist., bbl. | gal. | .85 - .... |
| Wood, dest. dist., bbl. | gal. | .65 - .... |
| Pine tar pitch, bbl. | 200 lb. | 5.50 - .... |
| Tar, kiln burned, bbl. | 500 lb. | 11.00 - .... |
| Retort tar, bbl. | 500 lb. | 11.00 - .... |
| Rosin oil, first run, bbl. | gal. | .41 - .... |
| Rosin oil, second run, bbl. | gal. | .45 - .... |
| Rosin oil, third run, bbl. | gal. | .47 - .... |
| Pine oil, steam dist. | gal. | .65 - .... |
| Pine tar oil, ref. | gal. | .50 - .... |

## Animal Oils and Fats

| | | |
|---|---|---|
| Degras, bbl. | lb. | $0.03½ - $0.05½ |
| Grease, yellow, loose | lb. | .07 - .07½ |
| Lard oil, Extra No. 1, bbl. | gal. | .85 - .... |
| Lard compound, bbl. | lb. | .12 - .12½ |
| Neatsfoot 20 deg., bbl. | gal. | 1.28 - .... |
| No. 1, bbl. | gal. | .88 - .92 |
| Oleo Stearine | lb. | .10½ - .... |
| Oleo oil, No. 1, bbl. | lb. | .11½ - .12 |
| Red oil distilled, d.p. bbl. | lb. | .08½ - .09½ |
| Saponified, bbl. | lb. | .08½ - .09½ |
| Tallow, extra, loose | lb. | .07½ - .... |
| Tallow oil, acidless, bbl. | gal. | .83 - .... |

## Vegetable Oils

| | | |
|---|---|---|
| Castor oil, No. 3, bbl. | lb. | $0.15½ - .... |
| Castor oil, No. 1, bbl. | lb. | .16 - .... |
| Chinawood oil, bbl. | lb. | .14½ - .15½ |
| Coconut oil, Ceylon, bbl. | lb. | .09½ - .... |
| Ceylon, tanks, N.Y. | lb. | .08½ - .... |
| Coconut oil, Cochin, bbl. | lb. | .10 - .10½ |
| Corn oil, crude, bbl. | lb. | .10½ - .11½ |
| Crude, tanks, (f.o.b. mill) | lb. | .09 - .... |
| Cottonseed oil, crude (f.o.b. mill), tanks | lb. | .08½ - .08½ |
| Summer yellow, bbl. | lb. | .10½ - .11 |
| Winter yellow, bbl. | lb. | .11½ - .... |
| Linseed oil, raw, car lots, bbl. | gal. | .90 - .... |
| Raw, tank cars (dom.) | gal. | .84 - .... |
| Boiled, cars, bbl. (dom.) | gal. | .92 - .... |
| Olive oil, denatured, bbl. | gal. | 1.25 - 1.30 |
| Sulphur, (foots) bbl. | lb. | .09½ - .10 |
| Palm, Lagos, casks | lb. | .07½ - .07½ |
| Niger, casks | lb. | .06½ - .... |
| Palm kernel, bbl. | lb. | .08½ - .08½ |
| Peanut oil, crude, tanks (mill) | lb. | .11½ - .... |
| Peanut oil, refined, bbl. | lb. | .14½ - .15 |
| Perilla, bbl. | lb. | .14 - .14½ |
| Rapeseed oil, refined, bbl. | gal. | .90 - .92 |
| Sesame, bbl. | lb. | .10½ - .11½ |
| Soya bean (Manchurian), bbl. | lb. | .11½ - .... |
| Tank, f.o.b. Pacific coast | lb. | .10 - .... |
| Tank, (f.o.b. N.Y.) | lb. | .10½ - .... |

## Fish Oils

| | | |
|---|---|---|
| Cod, Newfoundland, bbl. | gal. | $0.62 - $0.65 |
| Menhaden, light pressed, bbl. | gal. | .60 - .... |
| White bleached, bbl. | gal. | .62 - .... |
| Blown, bbl. | gal. | .66 - .... |
| Crude, tanks (f.o.b. factory) | gal. | .... - .... |
| Whale No. 1 crude, tanks, coast | lb. | .... - .... |
| Winter, natural, bbl. | gal. | .75 - .76 |
| Winter, bleached, bbl. | gal. | .78 - .79 |

## Oil Cake and Meal

| | | |
|---|---|---|
| Coconut cake, bags | ton | $30.00 - .... |
| Cottonseed meal, f.o.b. mills | ton | 38.00 - .... |
| Linseed cake, bags | ton | 35.00 - 36.00 |
| Linseed meal, bags | ton | 40.00 - 42.00 |

## Dye & Tanning Materials

| | | |
|---|---|---|
| Albumen, blood, bbl. | lb. | $0.50 - $0.55 |
| Albumen, egg, tech, kegs | lb. | .95 - .97 |
| Cochneal, bags | lb. | .32 - .34 |
| Cutch, Borneo, bales | lb. | .04½ - .04½ |
| Cutch, Rangoon, bales | lb. | .13½ - .14½ |
| Dextrine, corn, bags | 100 lb. | 3.74 - 3.94 |
| Dextrine, gum, bags | 100 lb. | 4.09 - 4.19 |
| Divi-divi, bags | ton | 38.00 - 39.00 |
| Fustic, sticks | ton | 30.00 - 35.00 |
| Fustic, chips, bags | lb. | .04 - .05 |
| Gambier com., bags | lb. | .10½ - .11½ |
| Logwood, sticks | ton | 25.00 - 26.00 |
| Logwood, chips, bags | lb. | .02½ - .03 |
| Sumac, leaves, Sicily, bags | ton | .... - .... |
| Sumac, ground, bags | ton | 140.00 - 150.00 |
| Sumac, domestic, bags | ton | 50.00 - 55.00 |
| Starch, corn, bags | 100 lb. | 3.12 - 3.22 |
| Tapioca flour, bags | lb. | .05½ - .06½ |

## Extracts

| | | |
|---|---|---|
| Archil, conc., bbl. | lb. | $0.16½ - $0.20 |
| Chestnut, 25% tannin, tanks | lb. | .01½ - .02½ |
| Divi-divi, 25% tannin, bbl. | lb. | .04 - .05 |
| Fustic, crystals, bbl. | lb. | .20 - .22 |
| Fustic, liquid, 42°, bbl. | lb. | .08 - .09 |
| Gambier, liq., 25% tannin, bbl. | lb. | .09½ - .10 |
| Hematine crys., bbl. | lb. | .14 - .18 |
| Hemlock, 25% tannin, bbl. | lb. | .03½ - .04 |
| Hypernic, solid, drums | lb. | .24 - .26 |
| Hypernic, liquid, 51°, bbl. | lb. | .09½ - .10½ |
| Logwood, crys., bbl. | lb. | .14 - .15 |
| Logwood, liq., 51°, bbl. | lb. | .08 - .09 |
| Osage Orange, 51°, liquid, bbl. | lb. | .07 - .08 |
| Osage Orange, powder, bg. | lb. | .14 - .15 |
| Quebracho, solid, 65% tannin, bbl. | lb. | .05 - .05½ |
| Sumac, dom., 51°, bbl. | lb. | .07 - .07½ |

## Dry Colors

| | | |
|---|---|---|
| Blacks–Carbongas, bags, f.o.b. works, contract | lb. | $0.09 - $0.11 |
| spot, cases | lb. | .12 - .16 |
| Lampblack, bbl. | lb. | .12 - .40 |
| Mineral, bulk | ton | 35.00 - 45.00 |
| Blues–Bronze, bbl. | lb. | .40 - .43 |
| Prussian, bbl. | lb. | .40 - .43 |
| Ultramarine, bbl. | lb. | .08 - .35 |
| Browns, Sienna, Ital., bbl. | lb. | .06 - .14 |
| Sienna, Domestic, bbl. | lb. | .03½ - .04 |
| Umber, Turkey, bbl. | lb. | .04 - .04½ |
| Greens–Chrome, C.P. Light, bbl. | lb. | .28 - .30 |
| Chrome, commercial, bbl. | lb. | .12 - .12½ |
| Paris, bulk | lb. | .26 - .28 |
| Reds, Carmine No. 40, tins | lb. | 4.50 - 4.70 |
| Iron oxide red, casks | lb. | .10 - .16 |
| Para toner, kegs | lb. | 1.00 - 1.10 |
| Vermilion, English, bbl. | lb. | 1.35 - 1.40 |
| Yellow, Chrome, C.P. bbls. | lb. | .16½ - .17 |
| Ocher, French, casks | lb. | .02½ - .03 |

## Waxes

| | | |
|---|---|---|
| Bayberry, bbl. | lb. | $0.20 - $0.21 |
| Beeswax, crude, Afr. bg. | lb. | .25 - .26 |
| Beeswax, refined, light, bags | lb. | .32 - .34 |
| Beeswax, pure white, cases | lb. | .40 - .41 |
| Candellila, bags | lb. | .23 - .23½ |
| Carnauba, No. 1, bags | lb. | .38 - .40 |
| No. 2, North Country, bags | lb. | .28½ - .29 |
| No. 3, North Country, bags | lb. | .19 - .20 |
| Japan, cases | lb. | .26 - .27 |
| Montan, crude, bags | lb. | .05½ - .06 |
| Paraffine, crude, match, 105-110 m.p., bbl. | lb. | .05½ - .... |
| Crude, scale 124-126 m.p. bags | lb. | .05½ - .... |
| Ref., 118-120 m.p., bags | lb. | .05½ - .... |
| Ref., 123–125 m.p., bags | lb. | .05½ - .... |
| Ref, 128-130 m.p., bags | lb. | .05½ - .... |
| Ref., 133-135 m.p., bags | lb. | .06 - .... |
| Ref., 135-137 m.p., bags | lb. | .06½ - .06½ |
| Stearic acid, sgle pressed, bags | lb. | .11 - .11½ |
| Double pressed, bags | lb. | .11½ - .11½ |
| Triple pressed, bags | lb. | .13 - .13½ |

## Fertilizers

| | | |
|---|---|---|
| Acid phosphate, 16%, bulk, works | ton | $7.50 - $7.75 |
| Ammonium sulphate, bulk f.o.b. works | 100 lb. | 2.70 - 2.75 |
| Blood, dried, bulk | unit | 4.10 - 4.15 |
| Bone, raw, 3 and 50, ground | ton | 26.00 - 28.00 |
| Fish scrap, dom., dried, wks. | unit | .... - .... |
| Nitrate of soda, bags | 100 lb. | 2.60 - 2.70 |
| Tankage, high grade, f.o.b. Chicago | unit | 2.00 - 2.10 |
| Phosphate rock, f.o.b. mines | | |
| Florida pebble, 68-72% | ton | 3.30 - 4.20 |
| Tennessee, 75% | ton | 7.00 - 7.25 |
| Potassium muriate, 80%, bags | ton | 34.55 - ....... |
| Potassium sulphate, bags basis 90% | ton | 45.85 - ....... |
| Double manure salt | ton | 27.00 - ....... |
| Kainit | ton | 7.22 - ....... |

## Crude Rubber

| | | |
|---|---|---|
| Para—Upriver fine | lb. | $0.19½ - ....... |
| Upriver coarse | lb. | .16 - ....... |
| Upriver caucho ball | lb. | .18 - ....... |
| Plantation—First latex crepe | lb. | .23½ - .23½ |
| Ribbed smoked sheets | lb. | .23 - ....... |
| Amber crepe No. 1 | lb. | .23 - ....... |

## Gums

| | | |
|---|---|---|
| Copal, Congo, amber, bags | lb. | $0.10 - $0.15 |
| East Indian, bold, bags | lb. | .20 - .21 |
| Manila, pale, bags | lb. | .19 - .20 |
| Pontinak, No. 1 bags | lb. | .19 - .20 |
| Damar, Batavia, cases | lb. | .24 - .24½ |
| Singapore, No. 1, cases | lb. | .31 - .32 |
| Singapore, No. 2, cases | lb. | .21½ - .22 |
| Kauri, No. 1, cases | lb | .62 - .64 |
| Ordinary chips, cases | lb. | .20½ - .21½ |
| Manjak, Barbados, bags | lb. | .08 - .11 |

## Shellac

| | | |
|---|---|---|
| Shellac, orange fine, bags | lb. | $0.58 - $0.59 |
| Orange superfine, bags | lb. | .60 - .61 |
| A. C. garnet, bags | lb. | .56 - .57 |
| Bleached, bonedry | lb. | .67 - .... |
| Bleached, fresh | lb. | .55 - .56 |
| T. N., bags | lb. | .56 - .... |

## Miscellaneous Materials

| | | |
|---|---|---|
| Asbestos, crude No. 1, f.o.b., Quebec | sh. ton | $300.00 - $400.00 |
| Asbestos, shingle, f.o.b., Quebec | sh. ton | 50.00 - 70.00 |
| Asbestos, cement, f.o.b., Quebec | sh. ton | 20.00 - 25.00 |
| Barytes, grd., white, f.o.b. mills, bbl. | net ton | 16.00 - 17.00 |
| Barytes, grd., off-color, f.o.b. Balt. | net ton | 13.00 - 14.00 |
| Barytes, floated, f.o.b. St. Louis, bbl. | net ton | 23.00 - 24.00 |
| Barytes, crude f.o.b. mines, bulk | net ton | 8.00 - 8.50 |
| Casein, bbl., tech. | lb. | .11 - .12 |
| China clay (kaolin) crude, No. 1, f.o.b. Ga. | net ton | 7.00 - 8.00 |
| Washed, f.o.b. Ga. | net ton | 8.50 - 9.00 |
| Powd., f.o.b. Ga. | net ton | 13.00 - 20.00 |
| Crude f.o.b. Va. | net ton | 6.00 - 8.00 |
| Ground, f.o.b. Va. | net ton | 13.00 - 19.00 |
| Imp., lump, bulk | net ton | 15.00 - 20.00 |
| Imp., powd. | net ton | 45.00 - 50.00 |
| Feldspar, No. 1 f.o.b. N.C. | long ton | 6.50 - 7.00 |
| No. 2 f.o.b. N.C. | long ton | 4.50 - 5.00 |
| No. 1 soap | long ton | 7.00 - ........ |
| No. 1 Canadian, f.o.b. mill, powd. | long ton | 20.00 - ........ |
| Graphite, Ceylon, lump, first quality, bbl. | lb. | .05½ - .06 |
| Ceylon, chip, bbl. | lb. | .04½ - .05 |
| High grade amorphous crude | ton | 15.00 - 35.00 |
| Gum arabic, amber, sorts, bags | lb. | .12 - .12½ |
| Gum tragacanth, sorts, bags | lb. | .48 - .53 |
| No. 1, bags | lb. | 1.25 - 1.30 |
| Kieselguhr, f.o.b. Cal. | ton | 40.00 - 42.00 |
| F.o.b. N. Y. | ton | 50.00 - 55.00 |
| Magnesite, calcined, f.o.b. Cal. | ton | 35.00 - 45.00 |
| Pumice stone, imp., casks | lb. | .03 - .35 |
| Dom., lump, bbl. | lb. | .05 - .05½ |
| Dom., ground, bbl. | lb. | .05 - .06 |
| Silica, glass sand, f.o.b. Ind. | ton | 2.00 - 2.50 |
| Silica, sand blast, f.o.b. Ind. | ton | 2.25 3.50 |
| Silica, amorphous, 200-mesh, f.o.b. Ill. | ton | 20.00 - ........ |
| Silica, glass sand, f.o.b. Ill. | ton | 1.75 - 3.00 |
| Soapstone, coarse, f.o.b. Vt., bags | ton | 7.50 - 8.00 |
| Talc, 200 mesh, f.o.b., Vt., bags, extra | ton | 10.00 - ........ |
| Talc, 200 mesh, f.o.b. Ga., bags | ton | 8.00 - 12.00 |
| Talc, 325 mesh, f.o.b. New York, grade A bags | ton | 14.75 - ........ |

## Mineral Oils

Crude, at Wells

| | | |
|---|---|---|
| Pennsylvania | bbl. | $4.00 - $4.50 |
| Corning | bbl. | 2.15 - ...... |
| Cabell | bbl. | 2.20 - ...... |
| Somerset | bbl. | 2.30 - 2.50 |
| Illinois | bbl. | 2.07 - ...... |
| Indiana | bbl. | 2.08 - ...... |
| Kansas and Okla. under 28 deg. | bbl. | 1.00 - ...... |
| California, 35 deg. and up | bbl. | 1.40 - ...... |

## Gasoline, Etc.

| | | |
|---|---|---|
| Motor gasoline, steel bbls. | gal. | $0.20 - ...... |
| Naphtha, V. M. & P. deod, steel bbls | gal | .19 - ...... |
| Kerosene, ref. tank wagon | gal. | .15 - ...... |
| Bulk, W.W. delivered, N.Y. | gal. | .08½ - ...... |
| Lubricating oils: | | |
| Cylinder, Penn., filtered | gal. | .32 - .38 |
| Bloomless, 30@31 grav. | gal. | .20 - ....... |
| Paraffin, pale | gal. | .18 - .18½ |
| Spindle, 200, pale | gal. | .22 - ....... |
| Petrolatum, amber, bbls. | lb. | .04 - .04½ |
| Paraffine wax (see waxes) | | |

## Refractories

| | | |
|---|---|---|
| Bauxite brick, 56% $Al_2O_3$, f.o.b. Pittsburgh | 1,000 | $140-$145 |
| Chrome brick, f.o.b. Eastern shipping points | ton | 45–47 |
| Chrome cement, 40-50% $Cr_2O_3$ | ton | 23–27 |
| 40-45% $Cr_2O_3$, sacks, f.o.b. Eastern shipping points | ton | 23.00 |
| Fireclay brick, 1st. quality, 9-in. shapes, f.o.b. Ky. wks. | 1,000 | 42–45 |
| 2nd. quality, 9-in. shapes, f.o.b. wks. | 1,000 | 35–38 |
| Magnesite brick, 9-in. straight (f.o.b. wks.) | ton | 65–68 |
| 9-in. arches, wedges and keys | ton | 80–85 |
| Scraps and splits | ton | 85 |
| Silica brick, 9-in. sizes, f.o.b. Chicago district | 1,000 | 50–53 |
| Silica brick, 9-in. sizes, f.o.b. Birmingham district | 1,000 | 50–53 |
| F.o.b. Mt. Union, Pa. | 1,000 | 42–45 |
| Silicon carbide refract. brick, 9-in. | 1,000 | 1180.00 |

## Ferro-Alloys

| | | |
|---|---|---|
| Ferrotitanium, 15-18% f.o.b. Niagara Falls, N.Y. | ton | $200.00 - ...... |

| | | |
|---|---|---|
| Ferrochromium, per lb. of Cr, 1-2% C | lb. | $0.30 -........ |
| 4-6% C | lb. | .11½-........ |
| Ferromanganese, 78-82% Mn, Atlantic seabd. duty paid | gr. ton | 107.50 -........ |
| Spiegeleisen, 19-21% Mn | gr. ton | 38.00 - 40.00 |
| Ferromolybdenum, 50-60% Mo, per lb. Mo | lb. | 2.00 - 2.50 |
| Ferrosilicon, 10-12% | gr. ton | 41.50 - 46.50 |
| 50% | gr. ton | 75.00 - 80.00 |
| Ferrotungsten, 70-80%, per lb. of W | lb. | .91 - .93 |
| Ferro-uranium, 35-50%, of U, per lb. of U | lb. | 4.50 -........ |
| Ferrovanadium, 30-40%, per lb. of V | lb. | 3.50 - 4.00 |

## Ores and Semi-finished Products

| | | |
|---|---|---|
| Bauxite, dom. crushed, dried, f.o.b. shipping points | ton | $5.50 - $8.75 |
| Chrome ore Calif. concentrates, 50% min. $Cr_2O_3$ | ton | 22.00 -........ |
| C.i.f. Atlantic seaboard | ton | 19 00 - 22.00 |
| Coke, fdry., f.o.b. ovens | ton | 4.75 - 5.25 |
| Coke, furnace, f.o.b. ovens | ton | 3.60 - 4.00 |
| Fluorspar, gravel, f.o.b. mines, Illinois | ton | 23.50 -........ |
| Ilmenite, 52% $TiO_2$ Va | lb. | .01½-........ |
| Manganese ore, 50% Mn, c.i.f. Atlantic seaport | unit | .44 - .46 |
| Manganese ore, chemical ($MnO_2$) | ton | 75.00 - 80.00 |
| Molybdenite, 85% $MoS_2$, per lb. $MoS_2$, N. Y. | lb. | .80 -........ |
| Monazite, per unit of $ThO_2$, c.i.f., Atl. seaport | lb. | .06 - .08 |
| Pyrites, Span., fines, c.i.f. Atl. seaport | unit | .11½- .12 |
| Pyrites, Span., furnace size, c.i.f. Atl. seaport | unit | .11½- .12 |
| Pyrites, dom. fines, f.o.b. mines, Ga | unit | .12 -........ |
| Rutile, 95% $TiO_2$ | lb. | .12 - .15 |
| Tungsten, scheelite, 60% $WO_3$ and over | unit | 9.25 -........ |
| Tungsten, wolframite, 60% $WO_3$ | unit | 9.00 - 9.25 |
| Uranium ore (carnotite) per lb. of $U_3O_8$ | lb. | 3.50 - 3.75 |
| Uranium oxide, 96% per lb. $U_3O_8$ | lb. | 12.25 - 2.50 |
| Vanadium pentoxide, 99% | lb. | 2.00 - 14.00 |
| Vanadium ore, per lb. $V_2O_5$ | lb. | 1.00 - 1.25 |
| Zircon 99% | lb. | .06 - .07 |

## Non-Ferrous Metals

| | | |
|---|---|---|
| Copper, electrolytic | lb. | $0.13½-........ |
| Aluminum, 98 to 99% | lb. | .27 - $.28 |
| Antimony, wholesale, Chinese and Japanese | lb. | .09½- .10 |
| Nickel, 99% | lb. | .27 - .30 |
| Monel metal, shot and blocks | lb. | .32 |
| Tin, 5-ton lots, Straits | lb. | .49 |
| Lead, New York, spot | lb. | .0790-.0825 |
| Lead, E. St. Louis, spot | lb. | .0770-.0775 |
| Zinc, spot, New York | lb. | .06475 |
| Zinc, spot, E. St. Louis | lb. | .06125 |
| Silver (commercial) | oz. | .64½ |
| Cadmium | lb. | .60 |
| Bismuth (500 lb. lots) | lb. | 2.35 |
| Cobalt | lb. | 2.50-3.00 |
| Magnesium, ingots, 99% | lb. | .90-.95 |
| Platinum, refined | oz. | 115 00 |
| Iridium | oz. | 275.00-300.00 |
| Palladium | oz. | 83.00 |
| Mercury | 75 lb. | 75.00-77.00 |
| Tungsten powder | lb. | .95-1.00 |

## Finished Metal Products

| | Warehouse Price Cents per Lb. |
|---|---|
| Copper sheets, hot rolled | 19.75 |
| Copper bottoms | 29.75 |
| Copper rods | 20.25 |
| High brass wire | 18.25 |
| High brass rods | 15.50 |
| Low brass wire | 20.00 |
| Low brass rods | 20.50 |
| Brazed brass tubing | 24.50 |
| Brazed bronze tubing | 25.75 |
| Seamless copper tubing | 22.75 |
| Seamless high brass tubing | 21.50 |

OLD METALS—The following are the dealers purchasing prices in cents per pound

| | |
|---|---|
| Copper, heavy and crucible | 11.00 @ 11.50 |
| Copper, heavy and wire | 10.75 @ 11.00 |
| Copper, light and bottoms | 9.00 @ 9.25 |
| Lead, heavy | 6.00 @ 6.25 |
| Lead, tea | 3.75 @ 4.00 |
| Brass, heavy | 6.00 @ 6.25 |
| Brass, light | 5.00 @ 5.25 |
| No. 1 yellow brass turnings | 7.00 @ 7.25 |
| Zinc scrap | 4.00 @ 4.25 |

## Structural Material

The following base prices per 100 lb. are for structural shapes 3 in. by ¼ in. and larger, and plates ¼ in. and heavier, from jobbers' warehouses in the cities named:

| | New York | Chicago |
|---|---|---|
| Structural shapes | $3.54 | $3.54 |
| Soft steel bars | 3.54 | 3.54 |
| Soft steel bar shapes | 3.54 | 3.54 |
| Soft steel bands | 4.39 | 4.39 |
| Plates, ¼ to 1 in. thick | 3.64 | 3.64 |

# Industrial

**Financial, Construction and Manufacturing News**

## Construction and Operation

### Alabama

BIRMINGHAM—The Dixie Metal Products Co., 1016 28th St., plans for the installation of a gas oven, enameling equipment, automatic drying apparatus and kindred equipment in its proposed 1-story addition, 50x125 ft., on which work will soon begin. D. D. Bentley is general manager.

### California

OAKLAND—The Pacific Gas & Electric Co., 445 Sutter St., San Francisco, has plans under way for a new artificial gas-generating plant on local site, estimated to cost approximately $145,000, with auxiliary equipment.

### District of Columbia

WASHINGTON—The Catholic University, Brookland district, has awarded a general contract to the C. J. Cassidy Co., 700 10th St., N. W., for the erection of a 2-story and basement chemical laboratory, 80x80 ft., estimated to cost $85,000. Murphy & Olmstead, 1413 H St., N. W., are architects.

### Florida

OLDSMAR—The Palmetto Oil Refining Co., Tampa, Fla., is said to have preliminary plans under advisement for the erection of a new local plant for the manufacture of palmetto oils, tannic acids and affiliated products. The works will include complete extracting and refining departments, and is estimated to cost close to $100,000, including machinery.

TAMPA—The First Psychological Development Association, recently formed with a capital of $1,000,000, has plans under way for the erection of a new plant in the Sulphur Springs section for the manufacture of special hollow tile products, designed for heavy pressures. It will consist of a number of buildings, with estimated cost placed in excess of $75,000, with equipment. Dr. H. L. Clough is president.

BRADENTOWN—The City Council has tentative plans under advisement for the construction of an artificial gas plant, for which it is purposed to issue bonds for $170,000. Details will be perfected at an early date.

### Illinois

EAST ST. LOUIS—The East St. Louis Castings Co. will begin the erection of a new 1-story foundry for the production of iron and steel castings, estimated to cost $38,000, including equipment. A general building contract has been let to the Bekley Brothers Construction Co., State St., East St. Louis.

CHICAGO—The Jewett & Sowers Oil Co., 20 West Jackson Blvd., petroleum products, has acquired the plant of the Power Oil Co., 633 West Pershing Rd., and will remodel and improve for a new works. It is proposed to remove the present plant to the new location. The compounding works will be increased in capacity and equipment installed for a new grease plant.

### Indiana

CARTHAGE—The American Paper Products Mfg. Co. has tentative plans under advisement for the rebuilding of the portion of its plant, destroyed by fire, April 12, with loss estimated at close to $90,000, including equipment. The reconstruction is expected to cost close to a like amount.

RICHMOND—The Board of Local Improvements, H. A. Dill, superintendent, will soon call for bids for the construction of a filtration plant at the municipal waterworks. Alvord, Burdick & Rowson, 8 South Dearborn St., Chicago, Ill., are engineers.

NOBLESVILLE—The Ball Brothers Co., Muncie, Ind., manufacturer of corrugated cardboard products, glass jars, etc., has arranged an expansion and improvement program for its local plant, comprising the former works of the American Strawboard Co., acquired several months ago at a receiver's sale. The project will include the installation of considerable additional machinery and improvements in present apparatus, and will involve about $250,000. The plant will be devoted to the manufacture of corrugated cardboard for cartons.

### Kentucky

LOUISVILLE—The Standard Sanitary Mfg. Co., Bessemer Bldg., Pittsburgh, Pa., manufacturer of enameled iron sanitary ware, etc., is having plans drawn by Joseph & Joseph, 800 Francis Bldg., Louisville, architects, for a 1-story and basement addition to its local plant at 6th and Shipp Sts., estimated to cost $150,000. It is understood that the new structure will be used largely for foundry service.

### Louisiana

SHREVEPORT—The Louisiana Oil Refining Corp. has tentative plans under consideration for the construction of a new carbon black manufacturing plant in the Cotton Valley section, with reported cost placed at close to $100,000, including equipment. R. B. Kahle is president.

### Maryland

BALTIMORE—The Pennsylvania Sugar Co., Pier 5, Pratt St., has awarded a general contract to the Kell-Philipp Co., Inc., Clarkson St., for the erection of a 1-story addition to its local refinery, 73x195 ft., estimated to cost $23,000, exclusive of equipment.

### Massachusetts

DANVERS—The Standard Crayon Co. has completed plans and will take bids at once for the erection of a 1-story addition to its plant, 40x52 ft., for which plans have been drawn by French & Hubbard, 210 South St., Boston, Mass., architects. The new structure will be equipped as a color works.

CAMBRIDGE—The Rinaldi Tile Co., Inc., 253 Atlantic Ave., Boston, manufacturer of ceramic tile, fine ceramics, etc., has commenced excavations for a new local plant on Carleton St., to be 3-story, 49x106 ft. The general building contract has been awarded to the F. J. Van Etten Co., 100 Boylston St., Boston. R. B. Whitten, 580 Massachusetts Ave., Cambridge, is architect.

HUDSON—Taveres & Co., Felton St., manufacturer of soda products, etc., are having plans drawn for the erection of a new 1-story plant on Broad St., 28x62 ft., and expects to ask bids at an early date. Earl V. Aldrich, 17 Wilson St., is architect.

ACTON—Fire, April 15, destroyed several buildings used for drying and other service at the plant of the American Smokeless Powder Co. An official estimate of loss has not been announced.

### Michigan

LANSING—The Lansing Fuel & Gas Co. will make extensions at its artificial gas plant for extensive increase in output, to include the installation of three additional retorts and auxiliary apparatus, boiler equipment, etc. It is expected to have the work completed in the fall.

DETROIT—The Michigan Copper & Brass Co., 5851 West Jefferson St., has completed plans and is taking bids for the erection of a 1-story addition at West Jefferson and Fort Wayne Sts., 86x405 ft. It will be equipped primarily as a rolling mill, with estimated cost placed in excess of $150,000. Lane, Davenport & Peterson, Dime Bank Bldg., Detroit, are architects and engineers.

### Minnesota

NORTHFIELD—The board of trustees, St Olaf's College, has asked bids on a general contract for the erection of a 3-story and basement chemical laboratory at the institution, to be 80x145 ft., estimated to cost $130,000, including equipment, of which a list will soon be prepared. Coolidge & Hogdon, 124 South La Salle St., Chicago, Ill., are architects. P. O. Holland is manager at the college.

## Missouri

VALLEY PARK—The Western Plate Glass Co. has taken over the local plant of the Universal Plate Glass Co., which has been idle for several years, and will occupy for a new works. Improvements will be made and necessary equipment installed. It is purposed to begin operations at an early date, giving employment to close to 200 operatives.

## New Jersey

LAMBERTVILLE—The Lambertville Pottery Co., North Union St., manufacturer of sanitary ware, has acquired the plant of the Smith & Sons Corp., on adjoining property, manufacturer of japanned pins and wire products, which is removing its works to Buffalo, N. Y., to be consolidated with the main factory at that location. The Lambertville company will use the property for immediate expansion in a number of departments, including four new kilns. Andrew Foltz is president of the purchasing company.

RIDGEFIELD—The Lowe Paper Co., River St., has plans for the erection of three additions to its local mill for considerable increase in output. The structures will be each 1-story, 40x260 ft., 48x120 ft. and 50x94 ft., respectively, estimated to cost $150,000, with equipment. Frederick L. Smith, 21 East 40th St., New York, is engineer.

CAMDEN—Fire, April 17, destroyed a portion of the glazed kid manufacturing plant of McNeely & Co., 72-78 Erie St., with loss estimated at $75,000, including equipment. It is planned to rebuild.

NEWARK—The Passaic Valley Sewerage Commission, 20 Branford Pl., has work under way on a new laboratory at the Newark Bay Pumping Station, to be equipped for chemical experimental work, including analysis of trade waste from the various manufacturing plants with deposits entering the new Passaic Valley sewerage system.

NEWARK—Lasker & Bernstein, Inc., 481 New Jersey Railroad Ave., operating a tannery for the production of chamois skins, etc., has commissioned Maximilian Zipkes, 25 West 43rd St., New York, architect, to prepare plans for a 4-story addition, 50x110 ft., to be used as a tannery. It is estimated to cost $150,000, with equipment, and will be erected by the Almil Realty Co., Inc., an affiliated organization. Allen Bernstein is president.

## New York

BROOKLYN—E. R. Squibb & Sons, 36 Doughty St., manufacturers of chemicals, etc., have plans in progress for an addition to their plant at Vine and Doughty Sts., including improvements in the present works, for which bids will soon be asked on a general contract. Russell G. Cory, 30 Church St., New York, is architect and engineer.

NORTH TONAWANDA—The Tonawanda Iron Co. is commencing an expansion and improvement program at its plant, to include the remodeling of existing buildings and the installation of considerable additional equipment. The plant will suspend operations during the work.

## Ohio

OSBORN—The Southwestern Portland Cement Co., El Paso, Tex., is reported to have acquired property on Reed's Hill, west of the city, as a site for a new mill, comprising about 1,000 acres with large deposits of limestone rock. The plant will consist of a number of buildings, with power house, estimated to cost close to $1,750,000. It is said that plans will be drawn at an early date and equipment purchases made.

UHRICHSVILLE—The Evans Clay Mfg. Co., Newport Ave., manufacturer of sewer pipe, drain tile and other heavy clay products, has plans under way for the erection of a 4-story addition, 80x160 ft., estimated to cost about $85,000, for which bids will soon be asked. N. W. Crites is manager.

## Oklahoma

WEST TULSA—Fire, April 11, destroyed a portion of the local plant of the Cosden Refineries, Inc., including three oil stills and auxiliary apparatus, with loss estimated at $225,000. It is planned to rebuild.

OKMULGEE—The Empire Refineries, Inc., has commenced the construction of a new unit at its local oil-refining plant, to be equipped primarily as a chemical products plant for the recovery of alcohols from heretofore waste petroleum byproduct materials, using a special process developed by the research department of the company. The cost is placed in excess of $200,000.

## Pennsylvania

MORRISVILLE—The Robertson Art Tile Co., Pennsylvania Ave., manufacturer of ceramic floor and wall tile, has construction in progress on a 2-story addition, 54x100 ft., to be used for assembly and other operating service. The kiln capacity has recently been increased.

STEELTON—The Bethlehem Steel Co., Bethlehem, Pa., has perfected plans for the erection of a new scrap-reclaiming plant at its local works, on site near the slab mill. The structure will be equipped with crushing machinery, and an electric magnet for separating the steel from the scrap, for recharging in the furnaces. It will cost in excess of $90,000.

## Texas

ITALY—The Italy Oil Mill Co. has tentative plans under consideration for the rebuilding of the portion of its local plant recently destroyed by fire with loss estimated at $75,000, including equipment.

BROWNWOOD—The Blue Ribbon Refinery, recently in receivership, has been acquired by Dr. W. M. Lang, Brownwood, and J. A. Goodman, Dallas, Tex. The new owners will take immediate possession and will make improvements in the mill, including equipment installation for larger refined oil output. It is expected to organize a company to operate the property.

## Virginia

NORFOLK — The Powhatan Super-Cord Tire Corp., recently organized with a capital of $1,000,000, has acquired local property and plans for the establishment of a new plant for the manufacture of automobile tires and tubes. Equipment will be installed for an initial output of about 500 tires daily. G. William Land, Norfolk, is president.

## Washington

LONGVIEW—The American Byproducts Co. is arranging for the immediate erection of the initial unit of a new plant, to cost about $40,000. Other structures will be constructed later to make an ultimate investment of $100,000, including machinery. Henry C. Prudhomme is general manager.

# New Companies

TROPICAL OIL CO., St. Petersburg, Fla.; refined oil products; $300,000. Incorporators: Roy L. Drew and Bainbridge Hayward, both of St. Petersburg.

P. & C. SUPPLY CO., New York, N. Y.; chemical specialties, abrasives, etc.; $50,000. Incorporators: P. E. Picotte, W. E. Sadler and A. M. Cusack. Representative: W. C. Kronmeyer, 67 Wall St., New York.

KEYSTONE PETROLEUM CORP., Los Angeles, Calif.; refined petroleum products; $750,000. Incorporators: George N. McCoy, C. E. Arnold and E. A. Drexler. Representative: Ward and L. M. Chapman, 1015 Citizens' National Bank Bldg., Los Angeles.

SUPERIOR GLASS CO., Providence, R. I.; glass products; 500 shares of stock, no par value. Incorporators: Louis Gerber, Maurice Robinson and Samuel J. Tannebaum, 83 Glenham St., Providence.

EAGLE PAPER CO., Jersey City, N. J.; paper products; 1,000 shares stock, no par value. Incorporators: M. L. Shannahan, A. L. Hermans and Arthur Pforr. Representative: Robert H. Brenner, 75 Montgomery St., Jersey City.

HUMPHREYS MFG. CORP., Brooklyn, N. Y.; chemicals and chemical compounds; $5,000. Incorporators: F. W. Humphreys, C. Kuhlman and R. C. Havens. Representative: J. G. Lazarus, Grand Central Terminal, New York.

BLACK-KEIDAISCH CO., Pittsburgh, Pa.; paints, varnishes, etc.; $15,000. J. S. Keidaisch, Banksville, Pa., is treasurer and representative.

LEDBETTER CHEMICAL CO., 2141 Cortez Ave., Chicago, Ill.; chemicals, varnishes, etc.; $10,000. Incorporators: Fred F. Ledbetter and Elmer E. Ledbetter.

AMERICAN PORTLAND CEMENT CO., Los Angeles, Calif.; operate a cement mill; $3,000,000. Incorporators: David Shepherd, C. E. Merryweather and O. T. Deal. Representative: George F. Rankin, 321 Pacific Finance Bldg., Los Angeles.

FARMASTIC PAINT CO., Philadelphia, Pa., care of the United States Corporation Co., Dover, Del., representative; paints, varnishes, etc.; $15,000.

GREEN-LOW-DOLGE, INC., New York, N. Y.; paper products; $30,000, and 450 shares common stock, no par value. Incorporators: A. W. Green, F. G. Low and O. A. Dolge. Representative: A. S. Marzo, 30 Church St., New York.

WHITE ROCK OIL CO., Dayton, O.; refined oil products; $20,000. Incorporators: Charles Zimmerman, E. L. Darby and A. W. Schulman, all of Dayton.

NICO WAX CO., Los Angeles, Calif.; waxes, compounds, etc.; $35,000. Incorporators: W. H. Nimock, Thomas Hunter and F. W. Steddom. Representative: Glen Behymer, 1215 Marsh-Strong Bldg., Los Angeles.

INTERNATIONAL SMELTING & REFINING CO., Detroit, Mich.; smelting and refining metals; nominal capital $3,000. Incorporators: Henry Rester and Frank Schage, 9501 Mt. Elliott Ave., Detroit.

TRI-STATE REFINING CO., care of the American Guaranty & Trust Co., 1600 Delaware Ave., Wilmington, Del., representative; operate oil-refining plants; $500,000.

MYERS & TURNER GLASS MFG. CO., Bellaire, O.; glass products; $100,000. Incorporators: C. O. Myers, Jorn Neuman and William Schulter, Jr., all of Bellaire. Representative: Capital Trust Co. of Delaware, Dover, Del.

PITTSBURGH CARDBOARD CO., Pittsburgh, Pa.; paper products; $10,000. Stanley M. Beilek, 5151 Butler St., Pittsburgh, is treasurer.

PNEUMOGUARD CHEMICAL CO., Knoxville, Tenn.; chemicals and chemical specialties; $25,000. Incorporators: J. D. Howard and Samuel Saunders, both of Knoxville.

ORANGE GLASS CO., Newark, N. J.; glass products; $40,000. Incorporators: Max Soffin, Abraham Roth and Jacob Schultz. Representative: Jacob Fischel, 790 Broad St., Newark.

CARBONDALE OIL CO., INC., 606 North Washington St., Carbondale, Ill.; refined oil products; $100,000. Incorporators: T. C. and W. O. Guerin, and J. F. Baggett.

INDUSTRIAL CHEMICAL CO., Louisville, Ky.; chemicals and chemical compounds; $30,000. Incorporators: Albert J. Gans and W. N. Morrill, both of Louisville.

# Industrial Notes

THE QUIGLEY FURNACE SPECIALTIES CO., Chicago office will be moved to larger quarters on May 1 at 9 South Clinton St.

THE THERMAL SYNDICATE on and after May 1 will be located at 58 Schenectady Ave., corner of Atlantic Ave., Brooklyn, N. Y., both the warehouse and office quarters being combined at this address.

THE CHASE CHEMICAL CO., 1050 Bolivar Road, Cleveland, O., has recently been organized to manufacture cobalt and manganese driers for the paint, varnish, linoleum and printing ink manufacturers. W. S. Chase, formerly research chemist for the Hawshaw, Fuller & Goodwin Co., heads the company.

THE DELORO SMELTING & REFINING CO., LTD., Ottawa, Ont., Canada, announces the appointment of Dr. S. F. Kirkpatrick as managing director and successor to the late Thomas Southworth.

THE COMBUSTION ENGINEERING CORP., New York, announces the appointment of Charles Longenecker, formerly sales engineer with the Bonnot Co. at Canton, O., who will be identified with the recently created industrial department, which is in charge of H. D. Savage.

THE H. K. FERGUSON CO., industrial engineers, Cleveland, Ohio, has opened a permanent sales and engineering office at Tokio, Japan, with John Parish of Cleveland, in charge. W. M. Thompson will be in charge of the laboratory and designing departments in the Oriental office.

THE SWENSON EVAPORATOR CO., of Philadelphia, Pa., has elected P. B. Sadtler, formerly Eastern district sales manager, as a vice-president in charge of sales at the main office at Harvey, Ill., succeeding F. M. deBeers, who recently resigned. Mr. deBeers will continue to act as a director of the Swenson Evaporator Co. H. B. Caldwell, who has been assisting Mr. Sadtler at Philadelphia, will remain in the East.

THE MENOMINEE RIVER SUGAR CO., Menominee, Mich., has elected G. W. McCormick president and general manager; G. A. Blesch treasurer, H. E. Britain secretary and L. G. Gray assistant secretary.